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A MODEL FOR EVALUATION OF REFINERY AND SYNFUELS VOC EMISSION DATA

Volume II. Appendices B and C

R.G. Wetherold, G.E. Harris, F.D. Skinner, L.P. Provost
Radian Corporation
P. O. Box 9948
Austin, Texas 78766

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EPA Project Officer: R. C. Lagemann
Air and Energy Engineering Research Laboratory
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

AIR AND ENERGY ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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The report describes the development of a model for estimating emissions of volatile organic compounds (VOCs) from petroleum refineries and synfuel plants. The model, responding to a need to define a consistent and comprehensive approach for estimating VOC emissions from these two sources, isa modular technique in which the entire spectrum of potential VOC emissions sources was defined in a number of process and utility modules. Each module represents a process or auxiliary unit. The user of the model provides emission source counts and other process information, or uses provided default values. Emissions are calculated using emission factors for each source type. Detailed examples of the application of the model to both refineries and synfuel plants are presented. Such estimates, of considerable interest to the EPA, industry, and the public, are needed in the preparation and review of Environmental Impact Statements (EIS) and permits required by the Clean Air Act. Responding to this need, several studies have been made of VOC emissions, particularly from refineries. Methods for estimating VOC emissions and the results of VOC emissions tests have been published in various journals and at various forums.

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Organic Compounds		Stationary Sources	07C	
Volatility	Liquefaction	Synfuel Plants	20M	07D
Refineries	Oil Shale	Synthetic Fuels	13I	08G
Mathematical Models		Volatile Organic Compounds (VOCs)	12A 14G	
Estimating				

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ABSTRACT

Estimates of the emissions of volatile organic compounds (VOCs) from petroleum refineries and synfuel plants are of considerable interest to EPA, industry, and the public. Such estimates are needed in the preparation and review of Environmental Impact Statements (EIS) and permits required by the Clean Air Act. In response to this need, several studies have been made of VOC emissions, particularly from refineries. Methods for estimating VOC emissions and the results of VOC emission tests have been published in various journals and at numerous forums. A need has developed to define a consistent and comprehensive approach for estimating VOC emissions from refineries and synfuel plants.

This study has resulted in the development of a model for performing such estimates. A modular technique was developed in which the entire spectrum of potential VOC emission sources was defined in a number of process and utility modules. Each module represents a process or auxiliary unit. The user of the model provides emission source counts and other process information, or uses default values provided. Emissions are calculated by the use of emission factors for each source type. Detailed examples of the application of the model to both refineries and synfuel plants are presented.

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APPENDIX B

EMISSION CALCULATION SHEETS

(Blank Forms)

EMISSION CALCULATION SHEET

MODULE NAME ____________________

FUGITIVE EMISSIONS

Source Type	Service (abb.)	Emission Factor (lb/day/source)		Population (# of sources)		Emissions (lb/day)
Pump Seals	Light Liquid (LL)	6.0	×	______ (see default #1)	=	______
Pump Seals	Heavy Liquid (HL)	1.1	×	______ (see default #1)	=	______
Compressor Seals	Hydrocarbon Gas (HCG)	34.0	×	______ (see default #2)	=	______
Compressor Seals	Hydrogen Gas (HYD)	2.6	×	______ (see default #2)	=	______
Valves	Hydrocarbon Gas (HCG)	1.4	×	______ (see default #3)	=	______
Valves	Hydrogen Gas (HYD)	0.43	×	______ (see default #3)	=	______
Valves	Light Liquids (LL)	0.58	×	______ (see default #3)	=	______
Valves	Heavy Liquids (HL)	0.012	×	______ (see default #3)	=	______
Connections	All	0.013	×	______ (see default #4)	=	______
Relief Valves	Gas (G)	8.6	×	______ (see default #5)	=	______
Relief Valves	Liquid (L)	0.37	×	______ (see default #5)	=	______
Open End Lines	All	0.12	×	______ (see default #6)	=	______
Process Drains	All	1.7	×	______ (see default #7)	=	______
Sample System Purging	All	0.79	×	______ (see default #7C) =	=	______

EMISSION CALCULATION SHEET (con't)

COMBUSTION EMISSIONS

Fuel Type		Emission Factor		Heater Duty (10^6 Btu/day)		Fuel Consumption			
Gas	Either	0.0029 lb/10^6 Btu	×	(see default #8)	=				
	Or	3.0 lb/10^6 scf		×		(see default #8)	10^6 scf/day	=	
Fuel Oil	Either	0.0667 lb/10^6 Btu	×	(see default #8)	=				
	Or	1.0 lb/10^3 gal		×		(see default #8)	10^3 gal/day	=	
Coal		1.0 lb/ton		×		(see default #8)	tons/day	=	

POINT SOURCE EMISSIONS

Vent or Stack Name	Vent Rate (scfd)		VOC Concentration (ppmv)		VOC Molecular Weight (lb/mol.)		
	(see default #9)	×	(see default #9)	×	(see default #9)	× 2.64×10^{-9} =	
		×		×		× 2.64×10^{-9} =	
		×		×		× 2.64×10^{-9} =	

Vent or Stack Name	Emission Factor (lb/unit)		Capacity (units/day)		
	(see default #9)	×	(see default #9)	=	
		×		=	
		×		=	

WASTEWATER GENERATION

Wastewater Generation Factor (10^6 gal•ww/10^3 Bbl Cap.)	Capacity (10^3 Bbl/day)		Wastewater Flow (10^6 gal/day)	
(see default #10)	(see default #10)	=		

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EMISSION CALCULATION SHEET (con't)

COMBUSTION EMISSIONS

Fuel Type		Emission Factor		Heater Duty (10^6 Btu/day)		Fuel Consumptio		
Gas	Either	0.0029 lb/10^6 Btu	×	____ (see default #8)	=			____
	Or	3.0 lb/10^6 scf		×		____ (see default #8)	10^6 scf/day =	____
Fuel Oil	Either	0.00667 lb/10^6 Btu	×	____ (see default #8)	=			____
	Or	1.0 lb/10^3 gal		×		____ (see default #8)	10^3 gal/day =	____
Coal		1.0 lb/ton		×		____ (see default #8)	tons/day =	____

POINT SOURCE EMISSIONS

Vent or Stack Name	Vent Rate (scfd)		VOC Concentration (ppmv)		VOC Molecular Weight (lb/mol.)		
____	____ (see default #9)	×	____ (see default #9)	×	____ (see default #9)	× 2.64×10^{-9} =	____
____	____	×	____	×	____	× 2.64×10^{-9} =	____
____	____	×	____	×	____	× 2.64×10^{-9} =	____

Vent or Stack Name	Emission Factor (lb/unit)		Capacity (units/day)		
____	____ (see default #9)	×	____ (see default #9)	=	____
____	____	×	____	=	____
____	____	×	____	=	____

WASTEWATER GENERATION

Wastewater Generation Factor (10^6 gal•ww/10^3 Bbl Cap.)	Capacity (10^3 Bbl/day)		Wastewater Flow (10^6 gal/day)	
____ (see default #10)	____ (see default #10)	=	____	____

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BOILERS

Emission Calculation

Emission Factor (lb VOC/unit of capacity)		Boiler Capacity (units/day)		VOC Emissions (lb/day)
________________	x	____________	=	____________

Defaults

a) The appropriate emission factors are:

- Gas Fired, Utility Boiler* - 0.001 lb/10^6 Btu
  or 1.0 lb/10^6 SCF
- Gas Fired, Industrial Boiler* - 0.0029 lb/10^6 Btu
  or 3.0 lb/10^6 SCF
- Oil Fired, Any Capacity -0.00667 lb/10^6 Btu
  or 1.0 lb/10^3 Gal.
- Coal Fired, Utility Boiler* - 0.3 lb/ton coal**
- Coal Fired, Industrial Boiler* - 1.0 lb/ton coal**

b) If the type of fuel is unknown, use
Gas = 89% , Fuel Oil = 10%, Coal = 1%.

c) If the boiler capacity is unknown, use
Total Boiler Capacity = 134,000 Btu/Bbl x _____ BPD Crude.

*Utility Boiler $\geq$ 100 x 10^6 Btu/hr., Industrial Boiler < 100 x 10^6 Btu/hr.

**Emission factors good for Bituminous and Lignite coals only, VOC emissions from Anthracite are negligible.

WASTEWATER TREATING

Oil-Water Separator

Emissions
(lb/day)

__________ x __________ = __________

Wastewater Flow Rate in 10^3 gal/day
(See Default No. 1)

Emission Factor
(See Default No. 2)

Dissolved Air Flotation Units

__________ x 0.09 lb/10^3 gal. WW = __________

Wastewater Flow Rate in 10^3 gal/day
(See Default No. 3)

Total Wastewater Emissions = __________
(Sum of the emissions from the OWS and DAF)

Default No. 1 - a) If the actual wastewater flow rate is unknown, add up the wastewater generation factors for each process module. These wastewater generation factors are based on the EPA Effluent Guidelines refinery flow model.

b) In the absence of any other reliable data, use 21 gal. of WW per bbl. of crude.

Default No. 2 - a) The emission factors for OWS are:
uncovered - 1.88 lb/10^3 gal. WW
covered - 0.38 lb/10^3 gal. WW
covered and vented - 0.06 lb/10^3 gal. WW
to a control device

b) If the type of emission control is unknown, assumed that the separator is covered.

Default No. 3 - a) If a DAF unit is known to be present but the wastewater flow rate is unknown, use the value calculated in Default No. 1.

b) If it is not known whether or not a DAF unit is part of the subject facility, assume that no DAF is included.

COOLING TOWERS

Emissions
(lb/day)

______________________	x 6 lb VOC/10^6 gal CW	=	__________
Cooling Water Circulation Rate in 10^6 gal/day			

Defaults a. If the cooling tower circulation rate is unknown, use 1670 gal CW/10^3 Bbl crude.

BLOWDOWN SYSTEM AND FLARES

________	x	________	x	________	x	________	x	(1- ________	x	$\frac{1}{379}$	= __________
Total flare capacity in scfd		Fraction of operating time		Vol. fraction of VOC		Mol. Wt. of the VOC in lb/mole		Fractional Destruction Efficiency			

Defaults a. If the input data for the above equation are not known, use

______________________	x 0.8 lb VOC/10^3 Bbl	=	________
Crude Charge Rate in 10^3 Bbl/day			

PRODUCT LOADING OPERATIONS

TANK TRUCKS/CARS

Emissions
(lb/day)

Gasoline

________________ X EF in lb VOC/10^3 gal = ________

Annual Average Amount of
Gasoline Loaded in 10^3 gal/day
(see Default Ia)

where EF = 5.0 for submerged loading-normal service
EF = 12.0 for splash loading-normal service
EF = 8.0 for submerged loading-vapor balance
EF = 8.0 for splash loading-vapor balance
(see Default IIa)

Jet Naphtha

________________ X EF in lb VOC/10^3 gal = ________

Annual Average Amount of
Jet Naphtha Loaded in
10^3 gal/day
(see Default Ib)

where EF = 1.5 for submerged loading-normal service
EF = 4.0 for splash loading-normal service
EF = 2.5 for submerged loading-vapor balance
EF = 2.5 for splash loading-vapor balance
(see Default IIb)

Kerosene

________________ X EF in lb VOC/10^3 gal = ________

Annual Average Amount of
Kerosene Loaded in
10^3 gal/day
(see Default Ic)

where EF = 0.02 for submerged loading
EF = 0.04 for splash loading
(see Default IIc)

No. 2 Fuel Oil

________________ X EF in lb VOC/10^3 gal = ________

Annual Average Amount of
No. 2 F.O. Loaded in
10^3 gal/day
(see Default Id)

where EF = 0.01 for submerged loading
EF = 0.03 for splash loading
(see Default IId)

No. 6 Fuel Oil

________________ X EF in lb VOC/10^3 gal = ________

Annual Average Amount of
No. 6 F.O. Loaded in
10^3 gal/day
(see Default Ie)

where EF = 0.0001 for submerged loading
EF = 0.0003 for splash loading
(see Default IIe)

PRODUCT LOADING OPERATIONS (Continued)

MARINE BARGES

Emissions (lb/day)

Gasoline

________________________ X EF in lb/10^3 gal = __________

Annual Average Amount of Gasoline Loaded in 10^3 gal/day (see Default If)

where EF = 1.2 for barges-cleaned and vapor free
EF = 4.0 for barges-uncleaned (dedicated service)
EF = 4.0 for barges-average condition
EF = 1.3 for ocean barges-cleaned and vapor free
EF = 2.1 for ocean barges-ballasted
EF = 3.3 for ocean barges-uncleaned (dedicated service)
(see Default IIf)

Jet Naphtha

________________________ X 1.2 lb/10^3 gal = __________

Annual Average Amount of Jet Naphtha Loaded in 10^3 gal/day (see Default Ig)

Kerosene

________________________ X 0.013 lb/10^3 gal = __________

Annual Average Amount of Kerosene Loaded in 10^3 gal/day (see Default Ih)

No. 2 Fuel Oil

________________________ X 0.012 lb/10^3 gal = __________

Annual Average Amount of No. 2 F.O. Loaded in 10^3 gal/day (see Default Ii)

No. 6 Fuel Oil

________________________ X 0.00009 lb/10^3 gal = __________

Annual Average Amount of No. 6 F.O. Loaded in 10^3 gal/day (see Default Ij)

PRODUCT LOADING OPERATIONS (Continued)

MARINE TANKERS

Emissions
(lb/day)

Gasoline

__________________ X EF in lb/10^3 gal = __________

Annual Average Amount of
Gasoline Loaded in
10^3 gal/day
(see Default Ik)

where EF = 1.0 for cleaned and vapor free
EF = 1.6 for ballasted
EF = 2.4 for uncleaned (dedicated service)
EF = 1.4 for average cargo tank condition
(see Default IIg)

Jet Naphtha

__________________ X 0.5 lb/10^3 gal = __________

Annual Average Amount of
Jet Naphtha Loaded in
10^3 gal/day
(see Default Il)

Kerosene

__________________ X 0.005 lb/10^3 gal = __________

Annual Average Amount of
Kerosene Loaded in
10^3 gal/day
(see Default Im)

No. 2 Fuel Oil

__________________ X 0.005 lb/10^3 gal = __________

Annual Average Amount of
No. 2 F.O. Loaded in
10^3 gal/day
(see Default In)

No. 6 Fuel Oil

__________________ X 0.00004 lb/10^3 gal = __________

Annual Average Amount of
No. 6 F.O. Loaded in
10^3 gal/day
(see Default Io)

PRODUCT LOADING OPERATIONS (Continued)

Defaults:

I. If the amounts of each stock loaded are not known, use the following values:

a. Gasoline to Tank Trucks and Cars (in 10^3 gal/day) = ________________ X 2.8
Crude Rate in 10^3 BPD

b. Jet Naphtha to Tank Trucks and Cars (in 10^3 gal/day) = ________________ X 1.2
Crude Rate in 10^3 BPD

c. Kerosene to Tank Trucks and Cars (in 10^3 gal/day) = ________________ X 1.8
Crude Rate in 10^3 BPD

d. No. 2 F.O. to Tank Trucks and Cars (in 10^3 gal/day) = ________________ X 1.2
Crude Rate in BPD

e. No. 6 F.O. to Tank Trucks and Cars (in 10^3 gal/day) = ________________ X 0.7
Crude Rate in BPD

f. Gasoline to Barges (in 10^3 gal/day) = ________________ X 0.6
Crude Rate in BPD

g. Jet Naphtha to Barges (in 10^3 gal/day) = ________________ X 0.2
Crude Rate in BPD

h. Kerosene to Barges (in 10^3 gal/day) = ________________ X 0.3
Crude Rate in BPD

i. No. 2 F.O. to Barges (in 10^3 gal/day) = ________________ X 0.8
Crude Rate in BPD

j. No. 6 F.O. to Barges (in 10^3 gal/day) = ________________ X 0.5
Crude Rate in BPD

k. Gasoline to Tankers (in 10^3 gal/day) = ________________ X 1.1
Crude Rate in BPD

l. Jet Naphtha to Tankers (in 10^3 gal/day) = ________________ X 0.4
Crude Rate in BPD

m. Kerosene to Tankers (in 10^3 gal/day) = ________________ X 0.5
Crude Rate in BPD

m. No. 2 F.O. to Tankers (in 10^3 gal/day) = ________________ X 2.5
Crude Rate in BPD

o. No. 6 F.O. to Tankers (in 10^3 gal/day) = ________________ X 1.5
Crude Rate in BPD

PRODUCT LOADING OPERATIONS (Continued)

Defaults (Continued):

II. If method of loading and receiving tank condition are not known, use

a. Gasoline to Tank Trucks and Cars - EF = 8.0 lb/10^3 gal

b. Jet Naphtha to Tank Trucks and Cars - EF = 2.5 lb/10^3 gal

c. Kerosene to Tank Trucks and Cars - EF = 0.04 lb/10^3 gal

d. No. 2 Fuel Oil to Tank Trucks and Cars - EF = 0.03 lb/10^3 gal

e. No. 6 Fuel Oil to Tank Trucks and Cars - EF = 0.0003 lb/10^3 gal

f. Gasoline to Barges - EF = 4.0 lb/10^3 gal

g. Gasoline to Tankers - EF = 1.4 lb/10^3 gal

FIXED ROOF TANK EMISSION CALCULATION SHEET
(See Default 1)

Breathing Loss

$$LB = (\ 6.16X10^{-5}\ )\ (M)\ \left(\frac{P}{14.7 - P}\right)^{0.68} (D)^{1.73} (H)^{0.51} (\Delta T)^{0.5} (FP)(C)(KC)$$

$$LB = (\ 6.16X10^{-5}\ )\ (M)\ \left(\frac{\quad}{14.7 - \quad}\right)^{0.68} (\quad)^{1.73} (\quad)^{0.51} (\quad)^{0.5} (\quad)\ (\quad)\ (\quad)$$

LB = ________________ lb/day

where: LB = Fixed roof breathing loss (lb/day)

M = Molecular weight of the vapor (lb/lb. mole), see Default 2a.

P = True vapor pressure at bulk liquid conditions (psia), see Default 2b.

D = Tank diameter (ft.), see Default 2c.

H = Average vapor space height (ft.), see Default 2d.

ΔT = Average ambient temperature change from day to night (°F), see Default 2e.

FP = Paint Factor (dimensionless), see Default 2f.

C = Small tank adjustment factor (dimensionless), see Default 2g.

KC = Crude oil factor (dimensionless), see Default 2h.

Working Loss

$$LW = (2.4 \times 10^{-2})(M)(P)(KN)(KC)$$

$$LW = (2.4 \times 10^{-2})\ (\quad)\ (\quad)\ (\quad)\ (\quad)$$

LW = _______________ lb/10^3 gal.

where: LW = Fixed roof working loss (lb/10^3 gal. throughput)
M = see above
P = see above
KN = Turnover factor (dimensionless), see Default 2i.
KC = Crude oil factor (dimensionless), see Default 2j.

Working Loss Per Day

LWPD = (LW)(TP) = ( ) ( ) = _______________ lb/day

where LWPD = Working loss per day (lb/day)
LW = see above
TP = Average daily throughput (10^3 gal./day), see Default 2k.

Total Emissions Per Tank

TEPT = (LB) + (LWPD) = ( ) + ( ) = _______________ lb/day

where TEPT = Total emissions per tank (lb/day)

Total Emissions for a Group of Identical Tanks

TEG = (TEPT)(N) = ( ) ( ) = _______________lb/day

where TEG = Total emissions for a group of identical tanks (lb/day)
TEPT = see above
N = Number of identical tanks in the facility under study, see Default 1b.

EXTERNAL FLOATING ROOF TANK EMISSION CALCULATION SHEET

(See Default 1)

Standing Storage Loss

$$LS = (M)\ \frac{0.068P}{(1 + \sqrt{1-0.068P})^2}\ (D)\ \ (VW)^{N}\ \ (KS)\ \ (KC)$$

$$LS = (\quad)\ \left[\frac{0.068\ (\quad)}{(1 + \sqrt{1-0.068\ (\quad)}\ )^2}\right]\ (\quad)\ \ (\quad)^{(\quad)}\ \ (\quad)\ \ (\quad)$$

LS = _______________ lb/day

where: LS = Floating roof standing storage loss (lb/day)
M = Molecular weight of the vapor (lb/lb. mole), see Default 2 a.
P = True vapor pressure at bulk liquid conditions (psia), see Default 2b.
D = Tank diameter (ft.), see Default 3a.
VW = Average wind velocity (mi/hr), see Default 3b.
N = Seal windspeed exponent (dimensionless), see Default 3c.
KS = Seal factor (dimensionless), see Default 3d.
KC = Crude oil factor (dimensionless), see Default 3e.

Withdrawal Loss

$$LWD = \frac{(943.7)\ (CF)\ (d)}{D} = \frac{(943.7)\ (\quad)\ (\quad)}{(\quad)}$$

LWD = _______________ $lb/10^3$ gal. throughput

where: LWD = Floating roof withdrawal loss ($lb/10^3$ gal throughput)
d = Density of stored liquid at bulk liquid conditions (lb/gal), see Default 3g.
CF = Tank clingage factor $Bbl./10^3\ ft.^2$
D = Tank diameter (ft), see Default 1c.

Withdrawal Loss Per Day

LWDPD = (LWD)(TP) = ( )( ) = __________ lb/day

where: LWDPD = Withdrawal loss per day (lb/day)
TP = Average daily throughput (10^3 gal/day), see Default 2k.

Total Emissions Per Tank

TEPT = (LS) + (LWDPD) = ( ) + ( ) = _______________ lb/day

Total Emissions for a Group of Identical Tanks

TEG = (TEPT)(No. of Tanks) = ( )( ) = __________ lb/day

INTERNAL FLOATING ROOF TANK EMISSION CALCULATION SHEET

(see Default 1.)

Rim Seal Loss

LR = (KR) (D) (P*) (M) (KC)

LR - (   ) (   ) (   ) (   ) (   ) = ______________ lb/day

where LR = Rim seal loss (lb/day)

KR = Rim seal loss factor (lb mole/ft.-yr.), see Default 4a

D = Tank diameter (ft.), see Default 3a

P^* = Vapor pressure function (dimensionless)

$$P^* = \frac{0.068P}{[1 + (1 - 0.068P)^{0.5}]^2}$$

P = True vapor pressure at bulk liquid conditions (psia), see Default 2b.

M = Molecular weight of the vapor (lb/lb - mole), see Default 2a

KC = Product factor (dimensionless), = 0.4 for crude

= 1.0 for others

Fitting Loss

LF = (FF) (P^*) (M) (KC)

= (   ) (   ) (   ) (   ) - ______________ lb/day

where FF = Total deck fitting loss factor (lb. mde/yr.)

$= (NF_1)\ (KF_1) + (NF_2)\ (KF_2) + \ldots + (NF_n)\ (KF_n)$

FF = (   ) (   ) + (   ) (   ) + (   ) (   ) + cont'd. lb-mole/yr

where NF; = Number of fittings of a particular type, see Default 4b

KF; = Fitting loss factor (lb-mole/yr), see Default 4b

and P^*, M, and KC as defined above.

Deck Seam Loss (Note: This term is zero for welded decks).

LD = (FD) (KD) $(D)^2$ (P^*) (M) (KC)

= (   ) (   ) $(\quad)^2$ (   ) (   ) (   ) = ______________ lb/day

where: LD = Deck seam loss (lb/day)
FD = Deck seam length factor (ft/ft^2), see Default 4c
KD = Deck seam loss factor (lb-mole/ft-yr.), see Default 4d.
and D, P^*, M, and KC are as defined above.

Standing Storage Loss

$$LS = LR + LF + LD$$

where: LS = Internal floating roof standing storage loss (lb/day)

Withdrawal Loss

$$LWD = \left[\frac{(943.7)\ (CF)\ (d)}{D}\right] \left[1 + \left(\frac{(NC)\ (FC)}{D}\right)\right]$$

$$LWD = \left[\frac{(943.7)\ (\quad)\ (\quad)}{(\quad)}\right] \left[1 + \left(\frac{(\quad)\ (\quad)}{(\quad)}\right)\right] = \underline{\qquad\qquad\qquad} \text{ lb/10}^3\text{ Gal.}$$

where: LWD = Withdrawal loss (lb/10^3 Gal.)
CF = Tank clingage factor (Bbl/10^3 ft.^{2}), see Default 3h.
d = Density of stored liquid at bulk liquid conditions (lb/Gal), see Default 3g.
D = Tank diameter (ft), see Default 1c.
NC = Number of support columns (dimensionless), see Default 4e.
FC = Effective column diameter (ft.), see Default 4f.

Withdrawal Loss Per Day

$$LWDPD = (LWD)\ (TP) = (\quad)\ (\quad) = \underline{\qquad\qquad\qquad} \text{ lb/day}$$

where: LWDPD = Withdrawal loss per day (lb/day)
TP = Average daily throughput (10^3 gal/day), see Default 2k.

Total Emissions Per Tank

TEPT = (LS) + (LWDPD) = (   ) + (   ) = ______________ lb/day

Total Emissions for a Group of Identical Tanks

TEG = (TEPT) (No. of Tanks) = (   ) (   ) = ______________ lb/day

STORAGE TANKS DEFAULT LISTING

Default No. 1. Distribution of Tank Types and Capacities

a. If the total tankage by stock is unknown, estimate it using the following average stock hold-up values:

$$\underset{\text{Crude Charge Rate (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{14 days}}{\text{Avg. Hold-up}} = \underset{\text{Total Crude Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

$$\underset{\text{Gasoline Production (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{40 days}}{\text{Avg. Hold-up}} = \underset{\text{Total Gasoline Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

$$\underset{\text{Jet Naphtha Production (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{68 days}}{\text{Avg. Hold-up}} = \underset{\text{Total Jet Naphtha Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

$$\underset{\text{Kerosene/AvJet Production (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{39 days}}{\text{Avg. Hold-up}} = \underset{\text{Total Kerosene/AvJet Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

$$\underset{\text{No. 2 Fuel Oil Production (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{56 days}}{\text{Avg. Hold-up}} = \underset{\text{Total No.2 Fuel Oil Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

$$\underset{\text{No. 6 Fuel Oil Production (BPD)}}{\underline{\hspace{5cm}}} \times \frac{\text{37 days}}{\text{Avg. Hold-up}} = \underset{\text{Total No.6 Fuel Oil Storage}}{\underline{\hspace{3cm}\text{Bbl.}}}$$

If the stock production rates are unknown, use

$$\text{Crude Charge Rate (BPD)} \left\{ \begin{array}{l} \text{—— x 0.445 = Gasoline Production} \\ \text{—— x 0.066 = Jet Naphtha Production} \\ \text{—— x 0.074 = Kerosene/AvJet Production} \\ \text{—— x 0.197 = No. 2 Fuel Oil Production} \\ \text{—— x 0.117 = No. 6 Fuel Oil Production} \end{array} \right.$$

b. If the total tankage by stock is known, but the individual tank sizes are unknown, use the following procedure:

1. Assume that all the tanks for a given stock are of equal size.
2. Estimate the number of tanks required so that the individual tank capacities fall within the typical range for each stock:

Stock	Typical Capacity	Typical Range
Crude	260,000 Bbl.	100,000 to 500,000 Bbl.
Gasoline	90,000 Bbl.	50,000 to 150,000 Bbl.
Jet Naphtha	50,000 Bbl.	30,000 to 75,000 Bbl.
Kerosene/AvJet	50,000 Bbl.	40,000 to 80,000 Bbl.
No. 2 Fuel Oil	70,000 Bbl.	50,000 to 100,000 Bbl.
No. 6 Fuel Oil	50,000 Bbl.	40,000 to 80,000 Bbl.

c. If the individual tank capacities are known, but the tank dimensions are unknown, use the following procedure:

1. Convert the capacity to cubic feet by

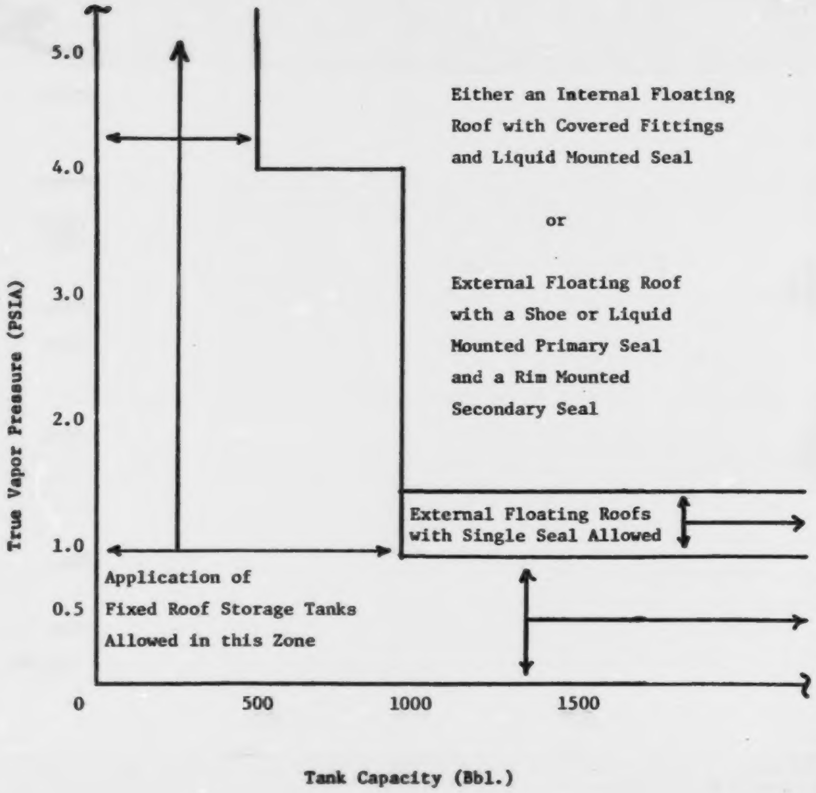
$$\text{Capacity (Bbl)} \times 5.65 \frac{\text{ft}^3}{\text{Bbl.}} = \text{Capacity (ft.}^3\text{)}$$

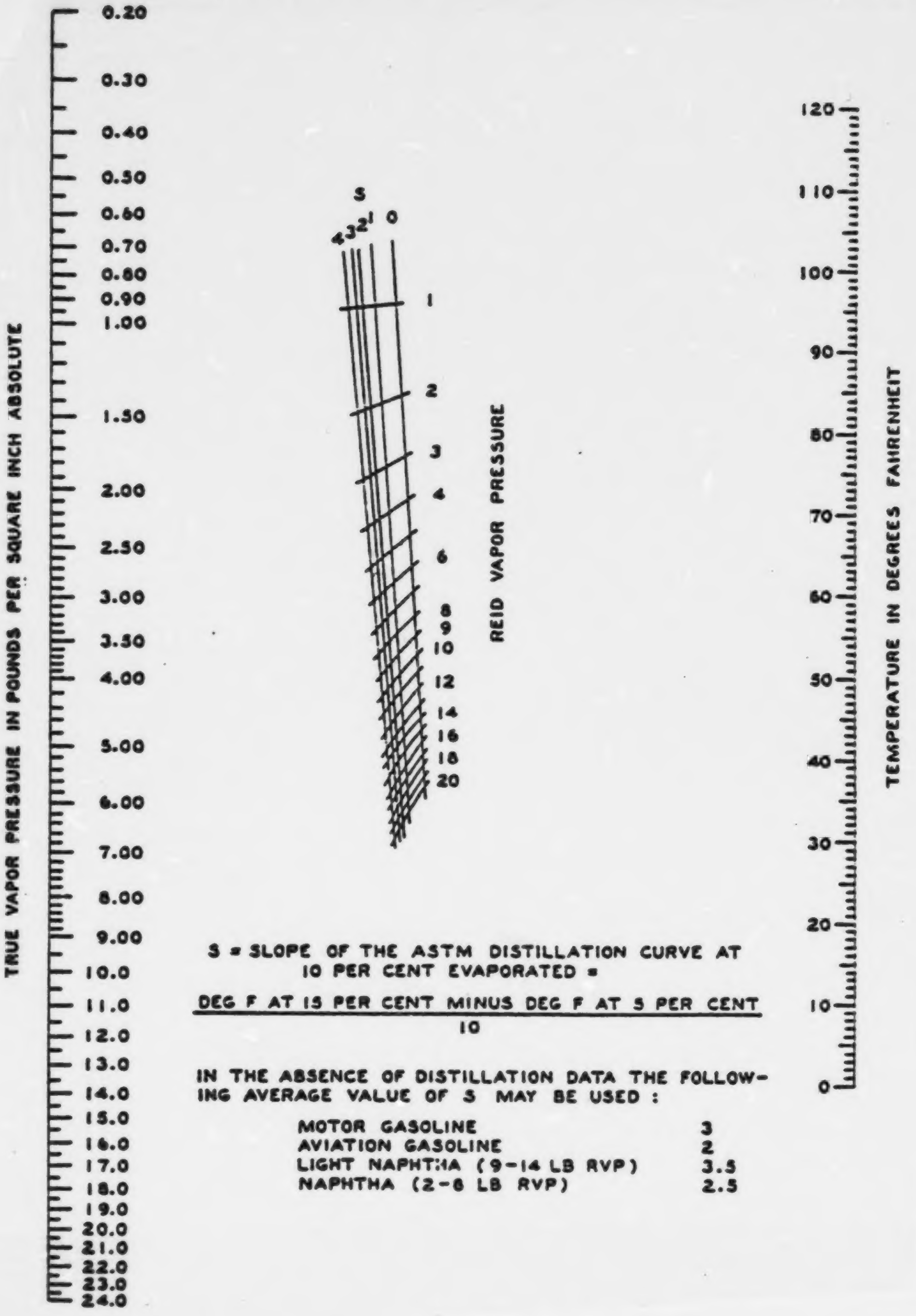
2. Assume a tank height - use 48 feet as a first guess for crude tanks and 40 feet for the major products.
3. Calculate the corresponding diameter by

$$D = \left[\frac{4\ (\text{capacity in ft.}^3)}{(\pi)\ (\text{Height in ft.})}\right]^{\frac{1}{2}}$$

4. Check if these dimensions are reasonable by calculating the ratio of the diameter to the height (D/H). If the value of D/H is less than 1.0, then decrease the assumed height by 8 feet and recalculate the diameter. If the value of D/H is greater than 6.0, then increase the assumed height by 8 feet and recalculate. Repeat this process until the value of D/H falls between 1.0 and 6.0.

d. If the tank type is unknown, assume that EPA control techniques guidelines have been followed. Those guidelines are illustrated graphically below. A pressure vessel or a vapor recovery system must be used if the TVP is greater than 11.1 psi. If the TVP of the stock is unknown, it can be estimated based on the Reid vapor pressure (RVP) and the storage temperature using Figure C-1 for products or Figure C-2 for crude. If the RVP of the stock is unknown, some typical properties for various stocks are given in Table C-1. In the absence of any other data, assume that floating roof tanks are used for crude, gasoline, and jet naphtha, and that fixed roof tanks are used for kerosene/AvJet, No. 2 fuel oil and No. 6 fuel oil.





S = SLOPE OF THE ASTM DISTILLATION CURVE AT 10 PER CENT EVAPORATED =

$$\frac{\text{DEG F AT 15 PER CENT MINUS DEG F AT 5 PER CENT}}{10}$$

IN THE ABSENCE OF DISTILLATION DATA THE FOLLOWING AVERAGE VALUE OF S MAY BE USED :

MOTOR GASOLINE	3
AVIATION GASOLINE	2
LIGHT NAPHTHA (9-14 LB RVP)	3.5
NAPHTHA (2-8 LB RVP)	2.5

Figure C-1. Vapor Pressures of Gasolines and Finished Petroleum Products

EMISSION FACTORS

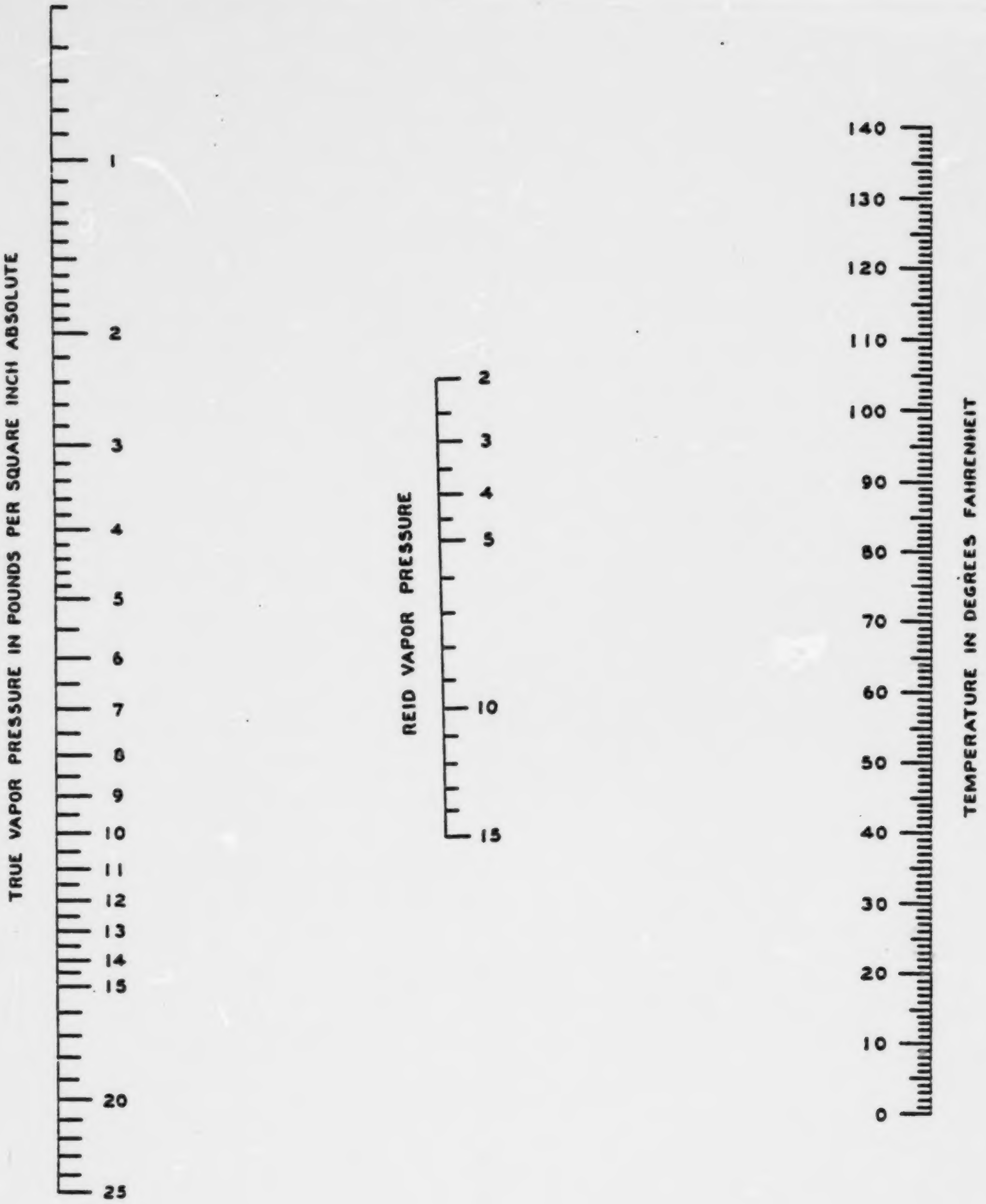


Figure C-2. Vapor Pressures of Crude Oil

TABLE C-1. PHYSICAL PROPERTIES OF HYDROCARBONS[7,9]

Hydrocarbon	Vapor molecular weight @ 60°F	Product density (d), lb/gal @ 60°F	Condensed vapor density (w), lb/gal @ 60°F	Vapor pressure in psia at:						
				40°F	50°F	60°F	70°F	80°F	90°F	100°F
Fuels										
Gasoline RVP 13	62	5.6	4.9	4.7	5.7	6.9	8.3	9.9	11.7	13.8
Gasoline RVP 10	66	5.6	5.1	3.4	4.2	5.2	6.2	7.4	8.8	10.5
Gasoline RVP 7	68	5.6	5.2	2.3	2.9	3.5	4.3	5.2	6.2	7.4
Crude oil RVP 5	50	7.1	4.5	1.8	2.3	2.8	3.4	4.0	4.8	5.7
Jet naphtha (JP-4)	80	6.4	5.4	0.8	1.0	1.3	1.6	1.9	2.4	2.7
Jet kerosene	130	7.0	6.1	0.0041	0.0060	0.0085	0.011	0.015	0.021	0.029
Distillate fuel No. 2	130	7.1	6.1	0.0031	0.0045	0.0074	0.0090	0.012	0.016	0.022
Residual oil No. 6	190	7.9	6.4	0.00002	0.00003	0.00004	0.00006	0.00009	0.00013	0.00019
Petrochemicals										
Acetone	58	6.6	6.6	1.7	2.2	2.9	3.7	4.7	5.9	7.3
Acrylonitrile	53	6.8	6.8	0.8	1.0	1.4	1.8	2.4	3.1	4.0
Benzene	78	7.4	7.4	0.6	0.9	1.2	1.5	2.0	2.6	3.3
Carbon disulfide	76	10.6	10.6	3.0	3.9	4.8	6.0	7.4	9.2	11.2
Carbon tetrachloride	154	13.4	13.4	0.8	1.1	1.4	1.8	2.3	3.0	3.8
Chloroform	119	12.5	12.5	1.5	1.9	2.5	3.2	4.1	5.2	6.3
Cyclohexane	84	6.5	6.5	0.7	0.9	1.2	1.6	2.1	2.6	3.2
1, 2 - Dichlorethane	99	10.5	10.5	0.6	0.8	1.0	1.4	1.7	2.2	2.8
Ethylacetate	88	7.6	7.6	0.6	0.8	1.1	1.5	1.9	2.5	3.2
Ethyl alcohol	46	6.6	6.6	0.2	0.4	0.6	0.9	1.2	1.7	2.3
Isopropyl alcohol	60	6.6	6.6	0.2	0.3	0.5	0.7	0.9	1.3	1.8
Methyl alcohol	32	6.6	6.6	0.7	1.0	1.4	2.0	2.6	3.5	4.5
Methylene chloride	85	11.1	11.1	3.1	4.3	5.4	6.8	8.7	10.3	13.3
Methyl-ethyl ketone	72	6.7	6.7	0.7	0.9	1.2	1.5	2.1	2.7	3.3
Methyl-methacrylate	100	7.9	7.9	0.1	0.2	0.3	0.5	0.8	1.1	1.4
1, 1, 1 - Trichloroethane	133	11.2	11.2	0.9	1.2	1.6	2.0	2.6	3.3	4.2
Trichloroethylene	131	12.3	12.3	0.5	0.7	0.9	1.2	1.5	2.0	2.6
Toluene	92	7.3	7.3	0.2	0.2	0.3	0.4	0.6	0.8	1.0
Vinylacetate	86	7.8	7.8	0.7	1.0	1.3	1.7	2.3	3.1	4.0

Default No. 2. Fixed Roof Storage Tank Defaults

a. If the molecular weight of vapor over the stock is unknown, refer to Table C-1. If the stock of interest is not listed, then select a similar stock and use its value as a rough estimate.

b. If the TVP of the stock is unknown, see Figures C-1 or C-2 to calculate the TVP based on RVP and storage temperature. If the exact storage temperature is unknown, use the annual average temperature for the location of the facility, or use 60°F in the absence of any site specific data. If the RVP is unknown, refer to Table C-1 for average TVP values of common stocks. If the stock of interest is not listed, then select a similar stock and use its value as a rough estimate.

c. If the tank diameter is unknown, see Default 1c.

d. If the average vapor space height is unknown, assume that it is half of the tank height. If the tank height is unknown, see Default 1c.

e. If the average diurnal temperature change is unknown, use 15°F.

f. If the paint factor is unknown, use:

Tank color		Paint factors (F_p) Paint condition	
Roof	Shell	Good	Poor
White	White	1.00	1.15
Aluminum (specular)	White	1.04	1.18
White	Aluminum (specular)	1.16	1.24
Aluminum (specular)	Aluminum (specular)	1.20	1.29
White	Aluminum (diffuse)	1.30	1.38
Aluminum (diffuse)	Aluminum (diffuse)	1.39	1.46
White	Gray	1.30	1.38
Light gray	Light gray	1.33	1.44
Medium gray	Medium gray	1.40	1.58

If the tank color is unknown, assume that it is specular aluminum (both roof and shell), and assume that it is in good condition.

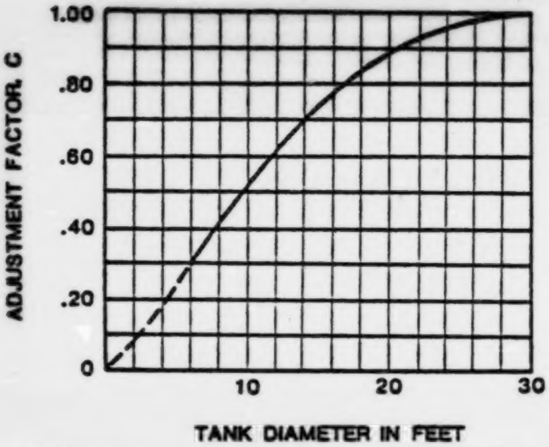
g. The small tank adjustment factor can be read from the following graph or in equation form:

For $D > 30$,

$C = 1.0$

For $D < 30$,

$C = 0.0771\ D - 0.0013D^2 - 0.1334$



Adjustment factor (C) for Small Diameter Tanks

h. The crude oil factor used in the breathing loss calculation is 0.65 for crude and 1.0 for all other stocks.

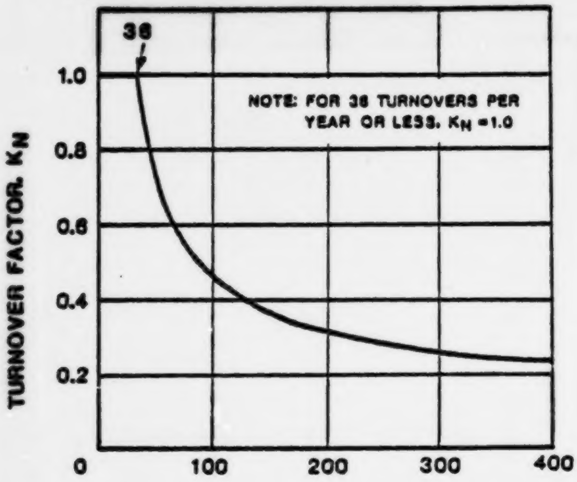
i. The turnover factor can be read from the following graph or in equation form:

For $TO \leqslant 36$

$Kn = 1.0$

For $TO > 36$

$Kn = 7.1283\ (TO)^{-0.575}$



TO = **TURNOVERS PER YEAR** = $\dfrac{\textbf{ANNUAL THROUGHPUT}}{\textbf{TANK CAPACITY}}$

If the annual throughput is unknown, it can be estimated by multiplying the average daily production (see Default 1a) by the number of operating days in the year (typically 330). This calculation yields the total throughput for a given stock, but this value must be distributed to all tankage holding that stock by allocating it in proportion to the tank capacity for a given tank relative to the total storage capacity for the stock.

j. The crude oil factor used in the working loss calculation is 0.84 for crude and 1.0 for all other stocks.

k. If the average daily throughput is unknown, it can be estimated from the production rate of the stock (see Default 1a) by:

_____________________ BPD x 42 gal/Bbl = ____________________ gal/day
Stock Production Rate   Total Daily Throughput

This value represents the total daily throughput for a given stock, and it must be distributed to all tankage holding that stock by allocating it in proportion to tank capacity relative to the total storage capacity for the stock.

Default No. 3. External Floating Roof Storage Tanks

a. If the tank diameter is unknown, see Default 1c. Note that for tanks with a diameter greater than 150 ft., substitute the expression

$$[(D)(150)^{0.5}]$$

for the $(D)^{1.5}$ shown in the equation.

b. If the average wind velocity for the site of the facility is unknown, use 6 miles per hour.

c. The tank type factor can be read from the table below:

Tank type	K_t
Welded tank with pan or pontoon roof, single or double seal	0.045
Riveted tank with pontoon roof, double seal	0.11
Riveted tank with pontoon roof, single seal	0.13
Riveted tank with pan roof, double seal	0.13
Riveted tank with pan roof, single seal	0.14

If the tank type is unknown, assume that it is a welded tank.

d. The seal type factor will be 1.0 for modern seals and 1.33 for loose fitting seals (typical of seals built prior to 1942).

e. The paint factor is 1.0 for light gray or aluminum colors and 0.9 for white. If the paint color is unknown, assume aluminum.

f. The crude oil factor for floating roof standing storage less calculation is 0.84 for crude and 1.0 for all other stocks.

g. If the liquid density of the stock at bulk liquid conditions is unknown, use the values given in Table C-1. If the particular stock of interest is not listed, select a similar stock and use its density as a rough estimate.

h. The tank construction factor is 0.02 for steel tanks and 1.0 for gunite lined tanks. If the actual tank construction is unknown, assume that it is unlined steel.

Default No. 4. Internal Floating Roof Storage Tanks

a. The rim seal loss factors (KR) for average fitting seals are:

Seal system description	KR (lb mole/ft-yr)
Vapor-mounted primary seal only	6.7
Liquid-mounted primary seal only	3.0
Vapor-mounted primary seal plus secondary seal	2.5
Liquid-mounted primary seal plus secondary seal	1.6

b. The deck fitting loss factor (KF) and typical numbers of various fitting types (NF) are given in tabular form on the next page.

c. The deck seam length factor (FD) is the length of the deck seams divided by the deck area. If these values are unknown, use:

0.15, for a deck constructed from continuous metal sheets with a 7 ft. spacing between seams

0.33, for a deck constructed from rectangular panels 5 ft. by 7.5 ft.

0.20, an approximate value for use when no construction details are known

d. The deck seam loss factor (KD) is:

0.34 lb-mole/ft.-yr for non-welded decks

or 0 lb-mole/ft.-yr for welded decks

Default 4b.

SUMMARY OF DECK FITTING LOSS FACTORS (K_f) AND TYPICAL NUMBER OF FITTINGS (N_f)[1]

Deck fitting type	Deck fitting loss factor, KF (lbmole/yr)	Typical number of fittings, (NF)
1. Access Hatch		1
a. Bolted cover, gasketed	1.6	
b. Unbolted cover, gasketed	11	
c. Unbolted cover, ungasketed	25	
2. Automatic Gauge Float Well		1
a. Bolted cover, gasketed	5.1	
b. Unbolted cover, gasketed	15	
c. Unbolted cover, ungasketed	28	
3. Column Well		(see Default 4.)
a. Built-up column-sliding cover, gasketed	33	
b. Built-up column-sliding cover, ungasketed	47	
c. Pipe column-flexible fabric sleeve seal	10	
d. Pipe column-sliding cover, gasketed	19	
e. Pipe column-sliding cover, ungasketed	32	
4. Ladder Well		1
a. Sliding cover, gasketed	56	
b. Sliding cover, ungasketed	76	
5. Roof Leg or Hanger Well		
a. Adjustable	7.9	$(5 + \frac{D}{10} + \frac{D^2}{600})^{**}$
b. Fixed	0	
6. Sample Pipe or Well		1
a. Slotted pipe-sliding cover, gasketed	44	
b. Slotted pipe-sliding cover, ungasketed	57	
c. Sample well-slit fabric seal, 10% open area	12	
7. Stub Drain*, 1-inch diameter	1.2	$(\frac{D^2}{125})^{**}$
8. Vacuum Breaker		1
a. Weighted mechanical actuation, gasketed	0.7	
b. Weighted mechanical actuation, ungasketed	0.9	

* Not used on welded, contact internal floating decks.

** D = tank diameter (ft).

Default No. 4 (Cont'd.)

Internal Floating Room Storage Tanks

e. If the number of support column is unknown, use:

Tank diameter range D (ft)	Typical number columns, NC
$0 < D \leq 85$	1
$85 < D \leq 100$	6
$100 < D \leq 120$	7
$120 < D \leq 135$	8
$135 < D \leq 150$	9
$150 < D \leq 170$	16
$170 < D \leq 190$	19
$190 < D \leq 220$	22
$220 < D \leq 235$	31
$235 < D \leq 270$	37
$270 < D \leq 275$	43
$275 < D \leq 290$	49
$290 < D \leq 330$	61
$330 < D \leq 360$	71
$360 < D \leq 400$	81

Note: This table was derived from a survey of users and manufacturers. The actual number of columns in a particular tank may vary greatly depending on age, roof style, loading specifications, and manufacturing perogatives. This table should not supersede information based on actual tank data.

f. If the effective column diameter is unknown, use:

Column Type	F_c (ft)
9 inch by 7 inch built up columns	1.1
8 inch diameter pipe columns	0.7
No construction details known	1.0

SOLID WASTE LANDTREATMENT EMISSION CALCULATION SHEET
(See Default 1.)

Model: Thibodeaux-Hwang (2)

Disposal Method: Landtreatment

Type of Model: Predictive

Basis: Emission rate is controlled by diffusion of vapor through the air-filled pores of the landtreated soil.

Form:

$$q_i = \frac{D_{ei}\, C_{ig}}{\left[h_s^2 + \dfrac{2\, D_{ei}\, t\, A\, (h_p - h_s) C_{ig}}{M_{io}}\right]^{1/2}}$$

and

$$C_{ig} = \left[\frac{H_c}{1 + H_c \dfrac{D_{ei}\, Z_o}{D_{wi}\, A_s\, f(\bar{y})}}\right] C_{io}$$

where

q_i = flux of component i from the soil surface, g/cm^2-sec

D_{ei} = effective diffusivity of component i in the air-filled soil pore spaces, cm^2/s

C_{ig} = effective wet zone pore space concentration of component i, g/cm^3

h_s = depth of subsurface injection (if applicable), cm

h_p = depth of soil contaminated or wetted with landtreated waste, cm

t = time after application, sec

A = surface area over which waste is applied, cm^2

M_{io} = initial mass of component i incorporated into the zone $(h_p - h_s)$, g

H_c = Henry's-law constant in concentration form, cm^3 oil/cm^3 air

Z_o = oil layer diffusion length, cm

D_{wi} = effective diffusivity of species i in the oil, cm^2/s

A_s = interfacial area per unit volume of soil for the oily waste, cm^2/cm^3

$f(\bar{y}) = \bar{y}\,(h_p - \bar{y})$, accounts for the lengthening dry zone

$\bar{y}$ = height of wetted soil remaining after partial drying, cm

SOLID WASTE LANDFILL EMISSION CALCULATION SHEET

(See Default 1.)

Model: Farmer (8) as modified by Shen (9) and Hwang (10)

Disposal Method: Covered Landfills

Type: Predictive

Basis: Emission rate is assumed to be mass transfer controlled by diffusion of gases through the soil pores (an adaptation of Fick's Law for diffusion of gaseous species through porous media).

Form:

$$E = 6DC_s\,A\,P_t^{4/3}\left(\frac{1}{L}\right)\left(\frac{W_i}{W}\right)$$

Symbol	Symbol/Parameter Definition	Source of Input Parameter
D	Diffusion coefficient of the species of interest in air (cm^2/sec)	Calculated value from literature or ratio to a compound with a known D by molecular weight.
C_s	Saturation vapor concentration (g/m^3)	Calculated from ideal gas law and species vapor pressure.
P	Vapor pressure of the species of interest (mm Hg)	Literature or direct measurement.
A	Surface area of the landfill (cm^2)	File data or direct measurement.
P_t	Soil porosity (dimensionless)	Can be estimated based on soil bulk density and soil particle density. Range is 0.25 to 0.62.
B	Soil bulk density (g/cm^3)	Varies from 1 to 2 g/cc. Need direct measurement for accuracy.
P	Soil particle density (g/cm^3)	Recommends 2.65 g/cc for most mineral material.
L	Depth of soil cover (cm)	File data or measurement.
W_i/W	Weight fraction of the species of interest in the disposed waste (g/g)	Direct measurement.

SURFACE IMPOUNDMENT EMISSION CALCULATION SHEET
(See Default 1.)

Model: Smith, Bomberger, and Haynes (11)

Disposal Method: Surface Impoundments

Basis: Expresses volatilization rate as a first-order kinetic equation. Recommends laboratory and/or literature approaches to determine the ratio of the volatilization rate constants for a high-volatility species of interest to that of oxygen. The reaeration rates of oxygen for natural water bodies are then used to estimate volatilization rates for the species of interest from natural water bodies assuming a constant value for the ratio.

Limitation: This relationship only holds for high volatility species where liquid phase resistance to mass transfer is dominant. This is true when the Henry's Law Constant, H_c, is greater than 3500 torr-liters/mole.

Equations:

$$E = (K^a)_{env.}\ (c)$$

$$(K^a)_{env.} = \left(\frac{K^a}{K^\circ}\right)_{lab} (K^\circ)_{env.}$$

Symbol	Symbol/Parameter Definition	Source of the Input Parameter
E	Mass emission rate per unit volume (lbs/gal.-day)	-
$(K^a)_{env.}$	Volatilization rate constant for compound "a" in the environment (day^{-1})	Calculated
c	Concentration of compound "a" (lbs/gal)	Measurement or file data
$\frac{K^a}{K^\circ}\ _{lab}$	Ratio of the volatilization constants of chemical "a" and oxygen as measured in the lab (dimensionless)	Measurement, literature, or estimation
$(K^\circ)_{env.}$	Oxygen reaeration rate in the environment (day^{-1})	Literature

SURFACE IMPOUNDMENT EMISSION CALCULATION SHEET

Model: Thibodeaux, Parker, and Heck (18)

Disposal Method: Surface Impoundment

Type of Model: Predictive

Basis: Mass transport theory concepts, with individual mass transfer coefficients obtained through the two resistance theory

Form:

$$q_i = M_i K_{li} (X_i - X_i^*)$$

and, for each volatile component i

$$K_l = (K_l^t A_t + K_l^n A_n)/(A_t + A_n)$$

$$\frac{1}{K_l^t} = \frac{1}{k_l^t} + \frac{1}{Hk_g^t}$$

$$\frac{1}{K_l^n} = \frac{1}{k_l^n} + \frac{1}{Hk_g^n}$$

Symbol	Symbol/Parameter Definition	Source of Input Parameters
q_i	Flux of component i from the impoundment surface, g/cm^2-s	-
M_i	Molecular weight of component i, g/g-mol	Published data
K_{li}	Overall liquid-phase mass transfer coefficient for component i, mol/cm^2-s	Calculation
X_i	Mole fraction of component i in the aqueous phase	Measured
X_i^*	Mole fraction of component i in equilibrium with the mole fraction of component i in the air, y_i. If y_i is assumed to be negligibly small, $X_i^* = 0$	Calculated from measured concentrations in the atmosphere
K_l^t, K_l^n	Overall liquid-phase mass transfer coefficients for the turbulent (aerated) and natural (unaerated) zones of the impoundment, respectively, mol/cm^2-s	Calculated
A_t, A_n	Surface areas of the turbulent and natural zones, respectively, cm^2	Measured

(Continued)

SURFACE IMPOUNDMENT EMISSION CALCULATION SHEET (Continued)

Symbol	Symbol/Parameter Definition	Source of Input Parameters
k_l^t, k_l^n	Individual liquid phase mass transfer coefficients for the turbulent and natural zones, respectively, mol/cm^2-s	Calculated from empirical correlations
k_g^t, k_g^n	Individual gas phase mass transfer coefficients for the turbulent and natural zones, respectively, mol/cm^2-s	Calculated from empirical correlations
H	Henry's law constant in mole fraction form, $y = Hx$	Published data or estimation

SOLID WASTE DISPOSAL
Default No. 1

There are no established emission factors for VOC emissions from solid waste disposal. There are a number of theoretical and empirical models which have been proposed to estimate these emissions, however, and a selection of these models have been included here for completeness. It is impossible to supply comprehensive default values for these models because of their complexity and theoretical nature. For those who have relied heavily upon the default values up to this point, omitting this calculation will have little or no effect on the accuracy of the total facility VOC emission estimate. For those who have had very detailed information for input to the previous calculations, the references that follow should provide sufficient detail for you to estimate or calculate the factors needed for each of the solid waste emission models.

VOC EMISSIONS FROM SOLID WASTE DISPOSAL

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APPENDIX C

DETAILED LISTING OF DEFAULT VALUES FOR EMISSION SOURCES IN REFINERIES AND SYNFUELS PLANTS

MODULE DEFAULT LISTING

MODULE NAME Atmospheric Crude Distillation

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 39 % and Heavy Liquid = 61 %.

c. In the absence of any other reliable data, use
Light Liquid service = 12 pump seals,
Heavy Liquid service = 19 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 41 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,
% Light Liquid = 0.9 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100
% Heavy Liquid = 0.9 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 126 valves,
Hyd Gas = 0 valves,
Light Liquid = 451 valves, and
Heavy Liquid = 687 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Atmospheric Crude Distillation

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 4444.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 16 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 96.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.8 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 56.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.3 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 40.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Atmospheric Crude Distillation

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
105,000 Btu/Bbl. Feed .

c. If the module capacity is unknown, use
BPD Feed = 1.0 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.004 x 10^6 Gal. WW/10^3 Bbl. Feed for the distillation complex alone, or 0.008 for distillation and desalting together.

b. If the module feed rate is unknown, use
BPD Feed = 1.0 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Vacuum Crude Distillation

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 5 % and Heavy Liquid = 95 %.

c. In the absence of any other reliable data, use
Light Liquid service = 1 pump seals,
Heavy Liquid service = 21 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 39 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

% Light Liquid = 0.9 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

% Heavy Liquid = 0.9 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 82 valves,
Hyd Gas = 0 valves,
Light Liquid = 15 valves, and
Heavy Liquid = 720 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Vacuum Crude Distillation

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2738.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 67 %,
Liquid service = 33 %.

b. In the absence of any other reliable data, use
Gas service = 8 relief valves,
Liquid service = 4 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.0 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 62.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 2.0 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 42.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.0 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 20.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Vacuum Crude Distillation

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
75,000 Btu/ BBL Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.36 x BPD Crude.

Default No. 9 Point Source Emissions

a. If mechanical vacuum pumps or surface condensers are used to create vacuum, the VOC emissions are negligible.

b. If barometric condensers are used to create vacuum, the emission factor is 18 lb. VOC/10^3 Bbl. Feed.

c. If the module feed rate is unknown, use BPD Feed = 0.36 x BDP Crude.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is
0.004 x 10^6 Gal. WW/10^3 Bbl. Feed.

b. If the module feed rate is unknown, use
BPD Feed = 0.36 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Naphtha Hydrotreating

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 100 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
Light Liquid service = 14 pump seals,
Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 4 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 66 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 15 %, Hyd. Gas = 15 %,

$$\% \text{ Light Liquid} = 0.70 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.70 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 150 valves,
Hyd Gas = 144 valves,
Light Liquid = 633 valves, and
Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Naphtha Hydrotreating

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3264 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 13 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.5 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 48 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.8 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 25 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 23 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Naphtha Hydrotreating

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
70,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.21 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Middle Distillate Hydrotreating

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 24 % and Heavy Liquid = 76 %.

c. In the absence of any other reliable data, use
Light Liquid service = 4 pump seals,
Heavy Liquid service = 13 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 6 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 62 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 21 %, Hyd. Gas = 31 %,

$$\% \text{ Light Liquid} = 0.48 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.48 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 221 valves,
Hyd Gas = 328 valves,
Light Liquid = 129 valves, and
Heavy Liquid = 379 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Middle Distillate Hydrotreating

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3656 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 14 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 53 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.4 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 24 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 29 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Middle Distillate Hydrotreating

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
195,000 Btu/Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.12 x BPD Crude .

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Gas Oil Hydrotreating

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 1 % and Heavy Liquid = 94 %.

c. In the absence of any other reliable data, use
Light Liquid service = 1 pump seals,
Heavy Liquid service = 15 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 5 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 84 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 21 %, Hyd. Gas = 31 %,

$$\% \text{ Light Liquid} = 0.48 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.48 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 282 valves,
Hyd Gas = 417 valves,
Light Liquid = 40 valves, and
Heavy Liquid = 604 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Gas Oil Hydrotreating

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 2.6 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3500 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 14 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.3 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 53 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.5 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 24 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.8 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 29 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Gas Oil Hydrotreating

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
146,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.12 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Vacuum Resid Hydrodesulfurization

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 0 % and Heavy Liquid = 100 %.

c. In the absence of any other reliable data, use
Light Liquid service = 0 pump seals,
Heavy Liquid service = 11 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 4 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 71 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 3 %, Hyd. Gas = 32 %,
% Light Liquid = 0.65 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100
% Heavy Liquid = 0.65 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 24 valves,
Hyd Gas = 250 valves,
Light Liquid = 0 valves, and
Heavy Liquid = 510 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Vacuum Resid Hydrodesulfurization

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.
b. In the absence of any other reliable data, use
Total # connections = 2585 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.
b. In the absence of any other reliable data, use
Gas service = 12 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.8 x total # pump seals.
b. In the absence of any other reliable data, use
# open-end lines = 42 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 2.2 x total # pump seals.
b. In the absence of any other reliable data, use
# process drains = 24 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.6 x total # pump seals.
d. In the absence of any other reliable data, use
# sampling systems = 18 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Vacuum Resid Hydrodesulfurization

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
57,000 Btu/Bbl Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.04 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Catalytic Reforming

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 94 % and Heavy Liquid = 6 %.

c. In the absence of any other reliable data, use
Light Liquid service = 15 pump seals,
Heavy Liquid service = 1 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 6 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 59 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 13 %, Hyd. Gas = 10 %,

$$\% \text{ Light Liquid} = 0.77 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.77 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 122 valves,
Hyd Gas = 96 valves,
Light Liquid = 680 valves, and
Heavy Liquid = 40 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Catalytic Reforming

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.5 x total # valves.
b. In the absence of any other reliable data, use
Total # connections = 3266 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.
b. In the absence of any other reliable data, use
Gas service = 11 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.5 x total # pump seals.
b. In the absence of any other reliable data, use
# open-end lines = 56 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 2.0 x total # pump seals.
b. In the absence of any other reliable data, use
# process drains = 32 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.5 x total # pump seals.
d. In the absence of any other reliable data, use
# sampling systems = 24 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Catalytic Reforming

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
265,000 Btu/Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.21 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Aromatics Extraction

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 81 % and Heavy Liquid = 19 %.

c. In the absence of any other reliable data, use
Light Liquid service = 22 pump seals,
Heavy Liquid service = 5 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 49 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.9 \times \frac{\#\text{LL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.9 \times \frac{\#\text{HL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 133 valves,
Hyd Gas = 0 valves,
Light Liquid = 923 valves, and
Heavy Liquid = 274 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Aromatics Extraction

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 4479 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 18 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.2 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 88 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 52 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.3 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 36 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Aromatics Extraction

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
190,000 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = __________ x __________.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Catalytic Cracking

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 43 % and Heavy Liquid = 57 %.

c. In the absence of any other reliable data, use
Light Liquid service = 20 pump seals,
Heavy Liquid service = 26 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 8 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 46 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 29 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.71 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.71 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 617 valves,
Hyd Gas = 0 valves,
Light Liquid = 649 valves, and
Heavy Liquid = 844 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Catalytic Cracking

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 6925.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 11 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 2.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 132.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.0 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 65.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.1 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 67.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Catalytic Cracking

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
56,000 Btu/Bbl of fresh feed

c. If the module capacity is unknown, use
Bbl fresh feed = 0.29 x Crude charge rate

Default No. 9 Point Source Emissions

a. CO boiler flue gas contains a negligible amount of VOC. The same holds true for high temperature and oxidation promoted regeneration.

b. If no CO boiler is used, conventional regenerator flue gas has an emission factor of 220 lb VOC/10^3 Bbl fresh feed.

c. If the fresh feed rate is unknown, use Crude charge rate
Bbl fresh feed = 0.29.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.046 x 10^6 gal WW/10^3 Bbl fresh feed.

b. If the fresh feed rate is unknown, use Bbl fresh feed = 0.29 x Crude charge rate.

MODULE DEFAULT LISTING

MODULE NAME Hydrocracking

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 55 % and Heavy Liquid = 45 %.

c. In the absence of any other reliable data, use
Light Liquid service = 17 pump seals,
Heavy Liquid service = 14 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 6 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 30 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 0.09 %, Hyd. Gas = 0.10 %,

$$\% \text{ Light Liquid} = 0.81 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.81 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 85 valves,
Hyd Gas = 90 valves,
Light Liquid = 375 valves, and
Heavy Liquid = 307 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Hydrocracking

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.0 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3724.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 6 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.6 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 111.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 58.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 53.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Hydrocracking

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
200,000 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.13 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.046×10^6 gal WW per 10^3 bbl feed.

b. If the module feed rate is unknown, use
BPD Feed = 0.13 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Thermal Cracking and Visbreaking

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 17 % and Heavy Liquid = 83 %.

c. In the absence of any other reliable data, use
Light Liquid service = 2 pump seals,
Heavy Liquid service = 12 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 25 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.9 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.9 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 30 valves,
Hyd Gas = 0 valves,
Light Liquid = 46 valves, and
Heavy Liquid = 224 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Thermal Cracking and Visbreaking

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.6 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1071 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 6 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.6 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 43 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 23 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 20 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Thermal Cracking and Visbreaking

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
90,000 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.14 x BPD Crude .

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.046×10^6 gal. WW/10^3 Bbl. Feed.

b. If the module feed rate is unknown, use BPD Feed = 0.14 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Delayed Coking

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 35 % and Heavy Liquid = 65 %.

c. In the absence of any other reliable data, use
Light Liquid service = 6 pump seals,
Heavy Liquid service = 11 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 1 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 61 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

$$\text{\% Light Liquid} = 0.9 \times \frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\text{\% Heavy Liquid} = 0.9 \times \frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 104 valves,
Hyd Gas = 0 valves,
Light Liquid = 197 valves, and
Heavy Liquid = 738 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Delayed Coking

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3473.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 16 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 2.5 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 43.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.4 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 23.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.5 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 25.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Delayed Coking

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
250,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.15 x BPD Crude .

Default No. 9 Point Source Emissions

a. The potential exists for significant VOC emissions during the coke cutting process, but no data are available to quantify those emissions. Unless site specific emission data are available, assume that this source is negligible.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Fluid Coking

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 23 % and Heavy Liquid = 77 %.

c. In the absence of any other reliable data, use
Light Liquid service = 3 pump seals,
Heavy Liquid service = 10 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 4 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 23 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.90 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.90 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 30 valves,
Hyd Gas = 0 valves,
Light Liquid = 58 valves, and
Heavy Liquid = 216 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Fluid Coking

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1047 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 6 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.9 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 50 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 2.2 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 28 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 22 .

MODULE NAME Fluid Coking

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/ Bbl Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.25 x BPD Crude.

Default No. 9 Point Source Emissions

a. CO boiler flue gas contains a negligible amount of VOC.

b. If no CO boiler is used, the burner vessel flue gas has an emission factor of 135 $lb/10^3$ Bbl. Feed.

c. If the module capacity is unknown, use BPD Feed = 0.25 x BPD Crude.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Light Ends Recovery and Fractionation

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 100 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
Light Liquid service = 27 pump seals,
Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 6 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 56 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 49 %, Hyd. Gas = 0 %,

% Light Liquid = 0.51 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

% Heavy Liquid = 0.51 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 733 valves,
Hyd Gas = 0 valves,
Light Liquid = 767 valves, and
Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Light Ends Recovery and Fractionation

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 5016 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 24 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.0 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 70 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 40 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.1 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 30 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Light Ends Recovery and Fractionation

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0.31 Btu/ scf of gas processed.

c. If the module capacity is unknown, use
scfd gas = 146 x BPD Crude.

Default No. 9 Point Source Emissons

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Miscellaneous Fractionation Units

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 86 % and Heavy Liquid = 14 %.

c. In the absence of any other reliable data, use
Light Liquid service = 19 pump seals,
Heavy Liquid service = 3 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 2 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 52 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,
% Light Liquid = 0.9 $\times \frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$
% Heavy Liquid = 0.9 $\times \frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$

c. In the absence of any other reliable data, use
HC Gas = 114 valves,
Hyd Gas = 0 valves,
Light Liquid = 911 valves, and
Heavy Liquid = 114 valves.

MODULE NAME Miscellaneous Fractionation Units

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3762.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 15 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.0 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 64.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 40.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.1 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 24.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Miscellaneous Fractionation Units

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
90,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.11 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Alkylation

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
   # pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
   Light Liquid = 100 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
   Light Liquid service = 24 pump seals,
   Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
   # compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
   Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
   Hydrocarbon Gas Service = 2 compressor seals,
   Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
   Total # valves = 49 x total # of pump seals

b. If the service distribution is unknown, use
   HC Gas = 13 %, Hyd. Gas = 0 %,

$$\%\ \text{Light Liquid} = 0.87 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\%\ \text{Heavy Liquid} = 0.87 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
   HC Gas = 234 valves,
   Hyd Gas = 0 valves,
   Light Liquid = 942 valves, and
   Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Alkylation

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3936 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 12 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 75 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 47 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.2 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 28 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Alkylation

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
375,000 Btu/ Bbl. Alkylate

c. If the module capacity is unknown, use
BPD Alkylate = 0.063 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Polymerization

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 100 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
Light Liquid service = 17 pump seals,
Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 50 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 35 %, Hyd. Gas = 0 %,

% Light Liquid = 0.65 x $\frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

% Heavy Liquid = 0.65 x $\frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 300 valves,
Hyd Gas = 0 valves,
Light Liquid = 555 valves, and
Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Polymerization

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2820 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 11 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.0 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 51 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 32 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.1 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 19 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Polymerization

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
NA = ______ x ______.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation Factor

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Isomerization

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 100 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
Light Liquid service = 14 pump seals,
Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 4 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 46 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 37 %, Hyd. Gas = 16 %,
% Light Liquid = 0.47 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100
% Heavy Liquid = 0.47 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 238 valves,
Hyd Gas = 102 valves,
Light Liquid = 310 valves, and
Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Isomerization

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.6 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2321 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 6 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.6 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 50 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 26 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 24 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Isomerization

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
50,000 Btu/ Bbl. Prod.

c. If the module capacity is unknown, use
BPD Prod. = 0.05 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation Factor

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Lubes Processing - Volatile Organic Solvents

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use # pump seals = 1.5 x # of pumps.

b. If the service distribution is unknown, use Light Liquid = 40 % and Heavy Liquid = 60 %.

c. In the absence of any other reliable data, use
Light Liquid service = 8 pump seals,
Heavy Liquid service = 12 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use # compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 2 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use Total # valves = 36 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.9 \times \frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.9 \times \frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 73 valves,
Hyd Gas = 0 valves,
Light Liquid = 255 valves, and
Heavy Liquid = 398 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Lubes Processing - Volatile Organic Solvents

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.6 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2608 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 9 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.7 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 33 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 39 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 33 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Lubes Processing - Volatile Organic Solvents

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
85,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.02 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.048×10^6 Gal. WW/10^3 Bbl. Feed.

b. If the module feed rate is unknown, use BPD Feed = 0.02 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Other Lube Processing

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 0 % and Heavy Liquid = 100 %.

c. In the absence of any other reliable data, use
Light Liquid service = 0 pump seals,
Heavy Liquid service = 12 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 59 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 0 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 1.0 \times \frac{\#\text{LL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 1.0 \times \frac{\#\text{HL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 0 valves,
Hyd Gas = 0 valves,
Light Liquid = 0 valves, and
Heavy Liquid = 710 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Lube Processing

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.1 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2212 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 50 %,
Liquid service = 50 %.

b. In the absence of any other reliable data, use
Gas service = 6 relief valves,
Liquid service = 6 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.2 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 38 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 23 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.3 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 15 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Lube Processing

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.02 x BPD Crude.

Default No. 9 Point Source Emissions

a. Most of the process units represented by this module have no significant point source emissions. This should be assumed to be the case unless specific data to the contrary are available.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0.048×10^6 Gal. WW/10^3 Bbl. Feed.

b. If the module feed rate is unknown, use BPD Feed = 0.02 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Asphalt Production

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 0 % and Heavy Liquid = 100 %.

c. In the absence of any other reliable data, use
Light Liquid service = 0 pump seals,
Heavy Liquid service = 6 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 50 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 0 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 1.0 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 1.0 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 0 valves,
Hyd Gas = 0 valves,
Light Liquid = 0 valves, and
Heavy Liquid = 300 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Asphalt Production

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.6 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1080 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 50 %,
Liquid service = 50 %.

b. In the absence of any other reliable data, use
Gas service = 3 relief valves,
Liquid service = 3 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.6 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 21 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 11 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.7 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 10 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Asphalt Production

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
15,000 Btu/ Bbl. Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.05 x BPD Crude (for large integrated refineries)
BPD Feed = 0.30 x BPD Crude (for small asphalt specialty refineries)
BPD Feed = 0.12 x BPD Crude (for a weighted average of all refineries with asphalt processing)

Default No. 9 Point Source Emissions

a. The asphalt blowing unit stack is a potentially significant source of VOC emissions. This stream is normally incinerated, resulting in a controlled VOC emission factor of 1.2 lb VOC/ton of asphalt produced.

b. If the asphalt blowing unit is vented directly to the atmosphere, the uncontrolled emission factor is 60 lb VOC/ton of asphalt produced.

c. If the asphalt production is unknown, use
TPD Asphalt = 0.16 x BPD module feed.

d. If the module feed is unknown, see Default 8c.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is
0.048×10^6 Gal. WW/10^3 Bbl. Feed

b. If the module feed is unknown, see Default 8c.

MODULE DEFAULT LISTING

MODULE NAME Hydrogen Production

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 50 % and Heavy Liquid = 50 %.

c. In the absence of any other reliable data, use
Light Liquid service = 2 pump seals,
Heavy Liquid service = 2 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 6 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 251 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 7 %, Hyd. Gas = 8 %,

$$\% \text{ Light Liquid} = 0.85 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.85 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 70 valves,
Hyd Gas = 79 valves,
Light Liquid = 427 valves, and
Heavy Liquid = 427 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Hydrogen Production

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 3345 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 15 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 10.4 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 42 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 4.3 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 17 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 6.1 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 25 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Hydrogen Production

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
135,000 Btu/10^3 SCF H_2.produced.

c. If the module capacity is unknown, use
SCFD H_2 = 290 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Gasoline Treating

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 55 % and Heavy Liquid = 45 %.

c. In the absence of any other reliable data, use
Light Liquid service = 6 pump seals,
Heavy Liquid service = 5 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 71 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 5 %, Hyd. Gas = 0 %,

$$\%\ \text{Light Liquid} = 0.95 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\%\ \text{Heavy Liquid} = 0.95 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 28 valves,
Hyd Gas = 0 valves,
Light Liquid = 293 valves, and
Heavy Liquid = 244 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Gasoline Treating

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.3 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1880.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 50 %,
Liquid service = 50 %.

b. In the absence of any other reliable data, use
Gas service = 4 relief valves,
Liquid service = 4 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 33.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 20.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.2 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 13.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Gasoline Treating

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.44 x BPD Crude .

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Other Product Treating

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 0 % and Heavy Liquid = 100 %.

c. In the absence of any other reliable data, use
Light Liquid service = 0 pump seals,
Heavy Liquid service = 8 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 55 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 2 %, Hyd. Gas = 0 %,

$$\%\ \text{Light Liquid} = 0.98 \times \frac{\#\text{LL Pump Seals}}{\text{Total}\ \#\ \text{Pump Seals}} \times 100$$

$$\%\ \text{Heavy Liquid} = 0.98 \times \frac{\#\text{HL Pump Seals}}{\text{Total}\ \#\ \text{Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 10 valves,
Hyd Gas = 0 valves,
Light Liquid = 0 valves, and
Heavy Liquid = 430 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Product Treating

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1496.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 50 %,
Liquid service = 50 %.

b. In the absence of any other reliable data, use
Gas service = 1 relief valves,
Liquid service = 1 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.4 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 27.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 15.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.5 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 12.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Product Treating

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/Bbl Feed.

c. If the module capacity is unknown, use
BPD Feed = 0.05 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The wastewater generation factor is 0, which means that this module does not contribute significantly to the overall refinery wastewater loading.

MODULE DEFAULT LISTING

MODULE NAME Olefins Production

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 77 % and Heavy Liquid = 23 %.

c. In the absence of any other reliable data, use
Light Liquid service = 17 pump seals,
Heavy Liquid service = 5 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 4 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 103 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 54 %, Hyd. Gas = 0 %,
% Light Liquid = 0.46 x $\frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100
% Heavy Liquid = 0.46 x $\frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 1230 valves,
Hyd Gas = 0 valves,
Light Liquid = 804 valves, and
Heavy Liquid = 237 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Olefins Production

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.6 x total # valves.
b. In the absence of any other reliable data, use
Total # connections = 8180 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 86 %,
Liquid service = 14 %.
b. In the absence of any other reliable data, use
Gas service = 30 relief valves,
Liquid service = 5 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 5.2 x total # pump seals.
b. In the absence of any other reliable data, use
# open-end lines = 114 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 3.3 x total # pump seals.
b. In the absence of any other reliable data, use
# process drains = 73 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.9 x total # pump seals.
d. In the absence of any other reliable data, use
# sampling systems = 41 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Olefins Production

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
5800 Btu/ lb ethylene product

c. If the module capacity is unknown, use
lb/day ethylene = 3.8 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. The olefins unit will generate 0.15 gal. WW/lb. ethylene product as cooling tower blowdown.

b. If a quench water stream is routed to wastewater treating, its rate should be added to the blowdown rate.

c. If the module capacity is unknown, use lb/day ethylene = 3.8 x BPD Crude.

MODULE DEFAULT LISTING

MODULE NAME Other Volatile Petrochemicals

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 81 % and Heavy Liquid = 19 %.

c. In the absence of any other reliable data, use
Light Liquid service = 25 pump seals,
Heavy Liquid service = 6 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 50 % and Hydrogen Gas = 50 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 1 compressor seals,
Hydrogen Gas Service = 1 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 23 %, Hyd. Gas = 5 %,

$$\% \text{ Light Liquid} = 0.72 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.72 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 151 valves,
Hyd Gas = 30 valves,
Light Liquid = 427 valves, and
Heavy Liquid = 57 valves.

MODULE NAME Other Volatile Petrochemicals

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.4 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2247.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 82 %,
Liquid service = 18 %.

b. In the absence of any other reliable data, use
Gas service = 9 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 4.7 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 144.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 2.2 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 69.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 2.4 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 75.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Volatile Petrochemicals

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
100,000 Btu/Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.0025 x BPD Crude.

Default No. 9 Point Source Emissions

a. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. Although some of the units represented by this module will generate some wastewater, their contributions to overall refinery wastewater loadings are insignificant and may be neglected.

MODULE DEFAULT LISTING

MODULE NAME Other Low Volatility Petrochemicals

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 33 % and Heavy Liquid = 67 %.

c. In the absence of any other reliable data, use
Light Liquid service = 4 pump seals,
Heavy Liquid service = 8 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 50 % and Hydrogen Gas = 50 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 1 compressor seals,
Hydrogen Gas Service = 1 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 43 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 3 %,

$$\% \text{ Light Liquid} = 0.87 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.87 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 50 valves,
Hyd Gas = 15 valves,
Light Liquid = 127 valves, and
Heavy Liquid = 328 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Low Volatility Petrochemicals

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 1825.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 57 %,
Liquid service = 43 %.

b. In the absence of any other reliable data, use
Gas service = 8 relief valves,
Liquid service = 6 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 3.4 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 42.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.9 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 23.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 1.5 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 19.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Other Low Volatility Petrochemicals

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
20,000 Btu/ Bbl Feed .

c. If the module capacity is unknown, use
BPD Feed = 0.0025 x BPD Crude.

Default No. 9 Point Source Emissions

a. If this module is being used to represent a Phthalic Anhydride unit, the emission factor is 2.4 lb VOC/ton of product for the uncontrolled case or 0.1 lb VOC/ton of product if controlled by incineration.

b. In the absence of other data, assume that there are no significant point source emissions.

Default No. 10 Wastewater Generation

a. Although some of the units represented by this module will generate some wastewater, their contributions to overall refinery wastewater loading are insignificant and may be neglected.

MODULE DEFAULT LISTING

MODULE NAME Coal Preparation (Thermal Drying)

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 0 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 0 % and Heavy Liquid = 0 %.

c. In the absence of any other reliable data, use
Light Liquid service = 0 pump seals,
Heavy Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 0 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 0 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0 \times \frac{\text{\#LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0 \times \frac{\text{\#HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 0 valves,
Hyd Gas = 0 valves,
Light Liquid = 0 valves, and
Heavy Liquid = 0 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Coal Preparation (Thermal Drying)

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 0 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 0.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 0 %,
Liquid service = 0 %.

b. In the absence of any other reliable data, use
Gas service = 0 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 0 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 0.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 0 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 0.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 0.

MODULE NAME Coal Preparation (Thermal Drying)

Default No. 8 Combustion Emissions

In the absence of any other reliable data, assume combustion emissions are included in Default No. 9, Point Source Emissions.

Default No. 9 Point Source Emissions

The point source of VOC emissions associated with this module is the coal dryer flue or vent gas. Emission rates may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight: ____________ x ____________ x

Vent Rate, SCFD VOC Concentration, ppmv

____________ x 2.64 x 10^{-9} = ____________

VOC Mol. Wt., lb/mole

In the absence of any other reliable data, use:

Vent flow rate = 75 x Coal feed rate to dryer, ton/day

VOC Concentration = 700 ppmv

VOC Molecular Wt. = 60

b. Estimate based on emission factor:

____________ x ____________ = ____________

Emission factor, lb/ton coal feed Coal feed rate, tpd

In the absence of any other reliable data, use:

Emission factor = 8.5 x 10^{-3} lb/ton coal feed

Default No. 10 Wastewater Generation

The volume of wastewater generated depends on several factors, including the type of dryer, the coal moisture content before and after drying, and the coal feed rate.

For thermal dryers using hot combustion gases, assume that the coal moisture exits the stack with the rest of the flue gas.

MODULE NAME Coal Preparation (Thermal Drying)

Default No. 10 Wastewater Generation (Continued)

For steam autoclave-type dryers (e.g., Fleissner dryers), use the following:

$$\text{Wastewater rate, } \frac{10^6 \text{ gal}}{\text{day}} = \left[\frac{\text{Inlet coal moisture, \%}}{\text{100-Inlet coal moisture}} - \frac{\text{Outlet coal moisture, \%}}{\text{100-Outlet coal moisture}}\right]$$

$$\times \text{ Coal feed rate to dryer, } \frac{\text{tons}}{\text{day}} \text{ (dry basis)} \times 24 \times 10^{-4}$$

MODULE DEFAULT LISTING

MODULE NAME Slurry Drying

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 50 % and Heavy Liquid = 50 %.

c. In the absence of any other reliable data, use
Light Liquid service = 4 pump seals,
Heavy Liquid service = 4 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 5 %, Hyd. Gas = 0 %,

$$\%\ \text{Light Liquid} = 0.95 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\%\ \text{Heavy Liquid} = 0.95 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 8 valves,
Hyd Gas = 0 valves,
Light Liquid = 80 valves, and
Heavy Liquid = 80 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Slurry Drying

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 756.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 100 %,
Liquid service = 0 %.

b. In the absence of any other reliable data, use
Gas service = 4 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 9.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 13.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 5.

MODULE NAME Slurry Drying

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/________.

c. If the module capacity is unknown, use
________ = ________ x ________.

Ordinarily, there are no combustion emissions in slurry drying.

Default No. 9 Point Source Emissions

The point source of VOC typically associated with this module is the slurry dryer vent gas. Emission rates may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight: ________ x ________ x
Vent Rate, SCFD VOC Concentration, ppmv
________ x 2,64 x 10^{-9} = ________
VOC Mol. Wt., lb/mole

In the absence of other reliable data, use:
Vent flow rate = 2.7 x 10^6 SCFD
VOC Concentration = 40,000 ppmv
VOC Molecular Wt. = 98

b. Estimate based on emission factor:
________ x ________ = ________
Emission factor, lb/ton coal feed Coal feed rate, tpd

In the absence of other reliable data, use:
Emission factor = 3.8 lb/ton coal feed

Default No. 10 Wastewater Generation

The wastewater generation rate from slurry drying depends on the moisture levels in the raw coal and the dried coal. It can be estimated as follows:

MODULE DEFAULT LISTING (Continued)

MODULE NAME Slurry Drying

Default No. 10 Wastewater Generation (Continued)

$$\underset{\text{Raw Coal Feed Rate, tpd}}{\underline{\qquad\qquad\qquad\qquad}} \times \underset{\text{Raw Coal Moisture, wt \%}}{\underline{\qquad\qquad\qquad\qquad}} - \underset{\text{Dried Coal Flow Rate, tpd}}{\underline{\qquad\qquad\qquad\qquad}}$$

$$\times \underset{\text{Moisture Content, wt \%}}{\underline{\qquad\qquad\qquad\qquad}} \times 2.4 \times 10^{-6} = \underline{\qquad\qquad\qquad} 10^{6} \frac{\text{gal}}{\text{day}}$$

In the absence of other reliable data, assume:

Dried coal moisture = 4 wt %

Inlet moisture content = 38 wt % for lignite
25 wt % for subbituminous
10 wt % for bituminous

Dried coal flow rate = Raw Coal Feed Rate x (100-Raw Coal Moisture)/100

MODULE DEFAULT LISTING

MODULE NAME Coal Gasification/Gas Cooling

(See Note after Default No. 7)

Totals on per gasifier,
per cooling train basis

Default No. 1 Pump Seals

a. If the number of pump seals is unkonwn, use
   # pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
   Aqueous = 100 % and Hydrocarbon Liquid = 0 %.

c. In the absence of any other reliable data, use
   Aqueous service = 3 pump seals,
   Hydrocarbon Liquid service = 0 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
   # compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
   Hydrocarbon Gas = 0 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
   Hydrocarbon Gas Service = 0 compressor seals,
   Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
   Total # valves = 65 x total # of pump seals

b. If the service distribution is unknown, use
   HC Gas = 47 %, Hyd. Gas = 0 %,
   Hydrocarbon Liquid = 17 %,
   Aqueous = 36 %

c. In the absence of any other reliable data, use
   HC Gas = 92 valves; 50 per gasifier + 42 per cooling train
   Hyd Gas = 0 valves,
   Hydrocarbon Liquid = 34 valves per cooling train
   Aqueous = 70 valves per gasifier

MODULE DEFAULT LISTING (Continued)

MODULE NAME Coal Gasification/Gas Cooling

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 3.0 x total # valves.

b. If the service distribution is unknown, use
HC Gas = 50 %, Aqueous = 25 %.
Hydrocarbon Liquid = 25 %

c. In the absence of any other reliable data, use
HC Gas = 310 connections; 178 per gasifier + 132 per cooling train
Aqueous = 136 connections per gasifier
Hydrocarbon Liquid = 146 connections per cooling train

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 100 %,
Liquid service = 0 %.

b. In the absence of any other reliable data, use
Gas service = 8 relief valves per gasifier,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 3 per gasifier.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Coal Gasification/Gas Cooling

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 5 per gasifier.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 2 per gasifier.

NOTE: VOC emissions from the coal gasification module depend on the type of gasifier being used. Entrained-bed and fluid bed gasifiers (e.g., Texaco, Koppers-Totzek, Westinghouse, U-Gas) do not produce significant quantities of organics heavier than methane; therefore, VOC emissions from these gasifiers will be negligible. The above default values were developed specifically for Lurgi gasifiers. Note that since the VOC concentration of most Lurgi streams are lower than those for refineries, different emission factors should be used.

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/__________.

c. If the module capacity is unknown, use
__________ = __________ x __________.

Ordinarily, there are no combustion sources directly associated with this module.

MODULE NAME Coal Gasification/Gas Cooling

Default No. 9 Point Source Emissions

A possible uncontrolled point source of VOC emissions in this module is the low-pressure coal lockhopper vent. Emissions may be estimated using one of the following:

a. Emissions based on vent flow rate, VOC concentrations and molecular weight:

$$\underset{\text{No. of lockhopper vents}}{\underline{\qquad\qquad\qquad}} \times \underset{\text{Vent flow rate, SCFD}}{\underline{\qquad\qquad\qquad}} \times \underset{\text{VOC concentration, ppmv}}{\underline{\qquad\qquad\qquad}} \times 2.64 \times 10^{-9} = \underset{\text{VOC, lb/day}}{\underline{\qquad\qquad}}$$

In the absence of any other reliable data, use

Vent flow rate = 15,000 SCFD,

VOC concentration = 6400

VOC Molecular Wt. = 55 lb/mole

b. Emissions based on emission factor:

$$\underset{\text{Emission factor, lb VOC/ton coal}}{\underline{\qquad\qquad\qquad}} \times \underset{\text{Coal feed rate, tpd}}{\underline{\qquad\qquad\qquad}} = \underset{\text{Voc, lb/day}}{\underline{\qquad\qquad}}$$

In the absence of any other reliable data, use

Emission factor = 3.3×10^{-2} lb VOC/ton coal

Default No. 10 Wastewater Generation

a. The wastewater generation rate for the gasification/gas cooling module depends on the coal moisture and oxygen content; coal, steam and oxygen feed rates; and raw gas carbon monoxide and carbon dioxide flow rates:

$$\text{Wastewater flow rate, } 10^6 \text{ gal/day} = \left[1.125 \times O_2 \text{ rate, } \frac{\text{ton}}{\text{day}} + \left(\frac{1.125\text{xCoal } 0\%}{100} + \frac{\text{Coal } H_2O\%}{100}\right) \times \text{coal rate, } \frac{\text{ton}}{\text{day}} - 0.643 \times \text{CO rate, } \frac{\text{ton}}{\text{day}} - 0.818 \times CO_2 \text{ rate, } \frac{\text{ton}}{\text{day}}\right] \times 2.4 \times 10^{-4}$$

MODULE NAME Coal Gasification/Gas Cooling

Default No. 10 Wastewater Generation (Continued)

b. In the absence of any other data, use the following:

Wastewater flow rate = $(120\text{-}240) \times 10^{-6}$ x coal feed rate, $\frac{\text{ton}}{\text{day}}$

10^6 gal/day

Use lower limit for fluid bed, entrained bed, and low-Btu gasifiers; use upper limit for fixed bed (e.g., Lurgi) gasifiers.

MODULE DEFAULT LISTING

MODULE NAME Indirect Liquefaction - Methanol Synthesis

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 75 % and Heavy Liquid = 25 %.

c. In the absence of any other reliable data, use
Light Liquid service = 32 pump seals,
Heavy Liquid service = 11 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 4 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 25 %, Hyd. Gas = 0 %,

$$\% \text{ Light Liquid} = 0.75 \times \frac{\#\text{LL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.75 \times \frac{\#\text{HL Pump Seals}}{\text{Total \# Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 220 valves,
Hyd Gas = 0 valves,
Light Liquid = 510 valves, and
Heavy Liquid = 170 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Methanol Synthesis

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 4100 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 100 %,
Liquid service = 0 %.

b. In the absence of any other reliable data, use
Gas service = 60 relief valves,
Liquid service = 0 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 45 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 70 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 24 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Methanol Synthesis

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/__________.

c. If the module capacity is unknown, use
__________ = __________ x __________.

In the absence of any other reliable data, assume combustion emissions from this module = 0.

Default No. 9 Point Source Emissions

Methanol synthesis produces a purge gas stream containing light gases such as hydrogen, carbon monoxide, and carbon dioxide as well as some light hydrocarbons. This purge gas can be further processed in a methanation reactor to produce by-product SNG. Methanation, in turn, produces a CO_2-rich vent stream containing light hydrocarbons. VOC emissions for this vent may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight: __________ x __________ x
Vent Rate, SCFD   VOC Concentration, ppmv
__________ x 2.64×10^{-9} = __________
VOC Mol. Wt., lb/mole

In the absence of other reliable data, use:
Vent Flow Rate = 680 SCF/ton gas to methanation
VOC Concentration = 500 ppmv
VOC Molecular Wt. = 33 lb/mole

b. Estimate based on emission factor:
__________ x __________
Emission factor, lb/ton gas to methanation   Methanation feed gas rate, tpd
= __________

MODULE DEFAULT LISTING (Continued)

MODULE NAME Methanol Synthesis

Default No. 9 Point Source Emissions (Continued)

In the absence of any other reliable data, use:

Emission factor = 0.03 lb/ton gas

Default No. 10 Wastewater Generation

Wastewater is generated in this module in purification of the crude methanol product to yield fuel grade methanol. The rate may be estimated as a function of the amount of CO_2 reacted to methanol as follows:

a. Wastewater flow rate, 10^6 gal/day =

$$\underset{\text{CO}_2\text{ Inlet flow rate Methanol Synthesis, ton/day}}{\underline{\qquad\qquad\qquad}} \times \underset{\%\text{ of Inlet CO}_2\text{ converted to MeOH}}{\underline{\qquad\qquad\qquad}} \times 9.8 \times 10^{-7}$$

In the absence of any other reliable data, use % of CO_2 converted = 50%

b. In the absence of any other reliable data, this rate may be estimated as 3×10^{-6} (10^6 gal/ton coal)

MODULE DEFAULT LISTING

MODULE NAME Indirect Liquefaction - Fischer-Tropsch Synthesis

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 75 % and Heavy Liquid = 25 %.

c. In the absence of any other reliable data, use
Light Liquid service = 41 pump seals,
Heavy Liquid service = 14 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 60 % and Hydrogen Gas = 40 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 6 compressor seals,
Hydrogen Gas Service = 4 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 15 %, Hyd. Gas = 10 %,

$$\% \text{ Light Liquid} = 0.8 \times \frac{\#\text{LL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.6 \times \frac{\#\text{HL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 170 valves,
Hyd Gas = 110 valves,
Light Liquid = 645 valves, and
Heavy Liquid = 155 valves.

MODULE NAME Fischer-Tropsch Synthesis

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 4870 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 32 relief valves,
Liquid service = 4 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 60 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 90 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 30 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Fischer-Tropsch Synthesis

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/__________.

c. If the module capacity is unknown, use
__________ = __________ x __________.

In the absence of any other reliable data, assume combustion emissions from this module = 0.

Default No. 9 Point Source Emissions

Fischer-Tropsch synthesis produces a purge gas stream containing light gases such as hydrogen, carbon monoxide, and carbon dioxide as well as some light hydrocarbons. This purge gas can be further processed in a methanation reactor to produce by-product SNG. Methanation, in turn, produces a CO_2-rich vent stream containing light hydrocarbons. VOC emissions from this vent may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight: __________ (Vent Rate, SCFD) x __________ (VOC Concentration, ppmv) x __________ (VOC Mol. Wt., lb/mole) x 2.64×10^{-9} = __________

In the absence of any other reliable data, use:
Vent Flow Rate = 3200 SCF/ton gas to methanation
VOC Concentration = 1500 ppmv
VOC Molecular Wt. = 33 lb/mole

b. Estimate based on emission factor:
__________ (Emission factor, lb/ton gas to methanation) x __________ (Methanation feed gas rate, tpd)
= __________

In the absence of any other reliable data, use:
Emission factor = 0.40 lb/ton gas

MODULE NAME Fischer-Tropsch Synthesis

Default No. 10 Wastewater Generation

The Fischer-Tropsch synthesis module produces wastewater as a result of alcohol recovery processing steps. The rate may be estimated as a function of the amount of CO and CO_2 in the F-T synthesis gas:

a. Wastewater flow rate, 10^6 gal/day = [CO flow rate, tons/day x 1/28 + CO_2 flow rate, tons/day x 1/22] x 4.6 x 10^{-3}

b. In the absence of any other reliable data, the rate may be estimated as 60 x 10^{-6} (10^6 gal/ton coal)

MODULE DEFAULT LISTING

MODULE NAME Mobil M Synthesis

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 70 % and Heavy Liquid = 30 %.

c. In the absence of any other reliable data, use
Light Liquid service = 31 pump seals,
Heavy Liquid service = 13 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 4 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 20 %, Hyd. Gas = 0 %,
% Light Liquid = 0.7 x $\frac{\#\text{LL Pump Seals}}{\text{Total } \#\text{ Pump Seals}}$ x 100
% Heavy Liquid = 1.0 x $\frac{\#\text{HL Pump Seals}}{\text{Total } \#\text{ Pump Seals}}$ x 100

c. In the absence of any other reliable data, use
HC Gas = 195 valves,
Hyd Gas = 0 valves,
Light Liquid = 460 valves, and
Heavy Liquid = 270 valves.

MODULE NAME Mobil M Synthesis

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.5 x total # valves.
b. In the absence of any other reliable data, use
Total # connections = 4160.

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.
b. In the absence of any other reliable data, use
Gas service = 43 relief valves,
Liquid service = 5 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.
b. In the absence of any other reliable data, use
# open-end lines = 48.

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.
b. In the absence of any other reliable data, use
# process drains = 70.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.
d. In the absence of any other reliable data, use
# sampling systems = 24.

MODULE DEFAULT LISTING (Continued)

MODULE NAME __Mobil M Synthesis______________________________

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = __100__%, Fuel Oil = __0__%, and Coal = __0__%.

b. If the heater duties are unknown, use
__0__ Btu/________.

c. If the module capacity is unknown, use
________ = ________ x ________.

In the absence of any other reliable data, assume combustion emissions from this module = 0.

Default No. 9 Point Source Emissions

Mobil M synthesis produces a purge gas stream containing light gases such as hydrogen, carbon monoxide, and carbon dioxide, as well as some light hydrocarbons. This purge gas can be further processed in a methanation reactor to produce by-product SNG. Methanation, in turn, produces a CO_2-rich vent stream containing light hydrocarbons. VOC emissions from this vent may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight:

$$\underset{\text{Vent Rate, SCFD}}{\underline{\hspace{3cm}}} \times \underset{\text{VOC Concentration, ppmv}}{\underline{\hspace{4cm}}} \times \underset{\text{VOC Mol. Wt., lb/mole}}{\underline{\hspace{3.5cm}}} \times 2.64 \times 10^{-9} = \underline{\hspace{2cm}}$$

In the absence of any other reliable data, use:
Vent Flow Rate = 275 SCF/ton gas to methanation
VOC Concentration = 300 ppmv
VOC Molecular Wt. = 30 lb/mole

b. Estimate based on emission factor:

$$\underset{\text{Emission factor, lb/ton gas to methanation}}{\underline{\hspace{6cm}}} \times \underset{\text{Methanation feed gas rate, tpd}}{\underline{\hspace{6cm}}} = \underline{\hspace{2cm}}$$

In the basence of any other reliable data, use:
Emission factor = 0.007 lb/ton gas

MODULE NAME Mobil M Synthesis

Default No. 10 Wastewater Generation

The Mobil M synthesis module produces wastewater as a result of reaction of methanol over the Mobil M catalyst to form hydrocarbons and water. The rate may be estimated as a function of the mass flow rate of methanol to the synthesis reactors:

a. Wastewater flow rate, 10^6 gal/day = Methanol flow rate, tons/day x 1.35×10^{-4}

b. In the absence of any other reliable data, this rate may be estimated as 55×10^{-6} (10^6 gal/ton coal)

MODULE DEFAULT LISTING

MODULE NAME Direct Liquefaction

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Light Liquid = 40 % and Heavy Liquid = 60 %.

c. In the absence of any other reliable data, use
Light Liquid service = 10 pump seals,
Heavy Liquid service = 14 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 100 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 2 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 21 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 10 %, Hyd. Gas = 10 %,

$$\% \text{ Light Liquid} = 0.8 \times \frac{\#\text{LL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

$$\% \text{ Heavy Liquid} = 0.8 \times \frac{\#\text{HL Pump Seals}}{\text{Total } \# \text{ Pump Seals}} \times 100$$

c. In the absence of any other reliable data, use
HC Gas = 50 valves,
Hyd Gas = 50 valves,
Light Liquid = 166 valves, and
Heavy Liquid = 237 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Direct Liquefaction

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 4.5 x total # valves.

b. In the absence of any other reliable data, use
Total # connections = 2268 .

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 80 %,
Liquid service = 20 %.

b. In the absence of any other reliable data, use
Gas service = 17 relief valves,
Liquid service = 4 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 26 .

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 37 .

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 13 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Direct Liquefaction

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
$3x10^{6}$ Btu/ ton slurry .
In the absence of other reliable data, assume 2.5 ton slurry per ton of coal input

c. If the module capacity is unknown, use
__________ = __________ x __________.

Default No. 9 Point Source Emissions

The typical point source of VOC in the Liquefaction module is the vacuum pressure separator (VPS) vent. Emission rates may be estimated in one of the following ways:

a. Estimate based on vent flow, VOC concentration, and molecular weight: ______________ x ______________ x ______________
Vent Rate, SCFD   VOC Conc., ppmv   VOC Mol. Wt., lb/mole
x 2.64×10^{-9} = ______________
Emission, lb/VOC/day

In the absence of other reliable data, assume:
Vent Flow Rate = 128,000 SCFD
VOC Concentration = 100% (10^{6} ppmv)
VOC Mol. Wt. = 46 lb/mole

b. Estimate based on emission factor:
______________________________ x ______________
Emission factor, lb/ton coal feed to liquefaction   Coal feed rate, tpd
= ______________
Emission, lb/VOC/day

If there are other point sources in the specific unit under study, emissions may be estimated using one of the methods above depending on the information available.

MODULE NAME Direct Liquefaction

Default No. 10 Wastewater Generation

The wastewater generation rate from Direct Liquefaction depends on the coal oxygen content and the amount of steam introduced in the product fractionation units. The generation rate may be estimated as:

$$[2.7 \times \underset{\text{Coal O Content, wt\%}}{\underline{\hspace{4cm}}} + 0.12 \times \underset{\text{Direct Steam Addition, lb/ton coal}}{\underline{\hspace{7cm}}}]$$

$$\times \underset{\text{Coal Feed Rate, tpd}}{\underline{\hspace{4cm}}} \times 10^{-6} = \underset{\text{Wastewater Generation, } 10^{6} \text{ gal/day}}{\underline{\hspace{7cm}}}$$

a. In the absence of other reliable data, assume the following coal oxygen content for various coal types:

lignite = 19%
subbituminous 13%
bituminous 9%, and
direct steam addition - 1716/ton coal

MODULE DEFAULT LISTING

MODULE NAME Above-Ground Oil Shale Retorting

Default Nos. 1-7 Process Fugitive Emissions

Insufficient information is currently available on shale-oil retorting to use source count and emission factor method of estimating process fugitive from this module.

In the absence of any other data, use the following:

Total fugitive VOC emission, lb/day = 0.014 x shale feed rate, tons/day

Default No. 8 Combustion Emissions

Combustion emissions of VOC depend on the shale retorting process being used.

a. If the fuel type is unknown, use:

	Gas	Oil
TOSCO II	0%	100%
Lurgi-Ruhigas	0%	0%
Paraho (Indirect)	100%	0%
Union B	100%	0%

b. If the heater duties are unknown, use:

TOSCO II	3.2×10^9 Btu/day
Lurgi-Ruhigas	0
Paraho (Indirect)	Assume same as for TOSCO II
Union B	Assume same as for TOSCO II

c. If the module capacity is unknown, use:

TOSCO II	21.5 (10^3 gal/day)
Lurgi-Ruhigas	0 (Emission source not present)
Paraho (Indirect)	4.0 (10^6 SCF/day)
Union B	4.0 (10^6 SCF/day)

MODULE DEFAULT LISTING (Continued)

MODULE NAME Above-Ground Oil Shale Retorting

Default No. 9 Point Source Emissions

The usual point source of VOC emissions in the Retorting module is the shale preheat flue gas. Emission rates may be estimated as:

____________________ x ____________________ =
Emission factor, lb VOC/ton shale   Shale retorting rate, ton/day

In the absence of any other reliable data, use
Emission factor, lb VOC/ton shale = 0.04.

Default No. 10 Wastewater Generation

Above-ground oil-shale retorting produces a foul wastewater which consists essentially of the gas condensate from the oil recovery system. It is made up of moisture from the shale as well as retorting steam. In the absence of any other reliable data, use:
Wastewater flow rate, 10^6 gal/day = 8.6×10^{-6} x Shale feed rate, ton/day

MODULE DEFAULT LISTING

MODULE NAME Acid Gas Removal

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# of pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Hydrocarbon Liquid = 95 % and Aqueous = 5 %.

c. In the absence of any other reliable data, use
Hydrocarbon Liquid service = 46 pump seals,
Aqueous service = 3 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 100 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas service = 0 compressor seals,
Hydrogen Gas service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 23 x total # of pump seals

b. If the service distribution is unknown, use
HC Gas = 20 %, Hyd. Gas = 0 %,
Hydrocarbon Liquid = 70 %
Aqueous = 10 %

c. In the absence of any other reliable data, use
HC Gas = 170 valves,
Hyd Gas = 0 valves,
Hydrocarbon Liquid = 545 valves, and
Aqueous = 80 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Acid Gas Removal

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connections = 2.8 x total # valves.

b. If the service distribution is unknown, use
HC Gas = 25 %; HC liquid 65 %
Aqueous = 10 %.

c. In the absence of any other reliable data, use
HC Gas = 560 connections
HC Liquid = 1460 connections
Aqueous = 210 connections

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 90 %,
Liquid service = 10 %.

b. In the absence of any other reliable data, use
Gas service = 12 relief valves,
Liquid service = 2 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 54 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Acid Gas Removal

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 78.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

c. In the absence of any other reliable data, use
# sampling systems = 27.

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0 %, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/________.

c. If the module capacity is unknown, use
________ = ________ x ________.

There are ordinarily no combustion sources associated with the acid gas removal module.

Default No. 9 Point Source Emissions

For acid gas removal processes operated in the selective mode (i.e., producing two acid gas streams, one lean in H_2S and the other containing the majority of the H_2S) the H_2S-lean gas, comprised mainly of CO_2 with small amounts of VOC and sulfur species, may be vented in an uncontrolled base plant.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Acid Gas Removal

Default No. 9 Point Source Emissions (Continued)

Emissions may be estimated based on one of the following:

a. Emissions based on vent flow rate, VOC concentration, and molecular weight:

______________ x ______________ x
Vent flow rate, SCFD VOC Concentration, ppmv

______________ $\times 2.64 \times 10^{-9} =$ ______________
VOC Mol. Wt., lb/mole VOC, lb/day

In the absence of any other reliable data, use
Vent flow rate = 3.2×10^{6} SCFD/gasifier
VOC concentration = 5000 ppmv (fixed bed gasifier); negligible to other types of gasifies
VOC Mol. Wt. = 29

b. Emissions based on Emission factor:

______________ x ______________ = ______________
Emission factor, lb/VOC/ton coal Coal feed rate, tpd VOC,lb/day

In the absence of any other reliable data, use
Emission factor = 2.7 lb VOC/ton coal

Default No. 10 Wastewater Generation

Some acid gas removal processes may incorporate a prewash step for the removal of heavy organics and water (e.g., Rectisal operating on Lurgi gasifier raw gas). In such cases, a process condensate will be generated. Wastewater generation may be estimated for such cases as follows:

Wastewater flow rate, 10^{6} gal/day = ______________ x
Generation factor, 10^{6} gal/ton coal

____
Coal flow rate, tpd

In the absence of any other reliable data, use
Generation factor = 9×10^{-6} (10^{6} gal/ton)

MODULE DEFAULT LISTING

MODULE NAME Oil-Soluble Arsenic Removal

At the present time, not enough data are available to be able to estimate VOC emissions from this module. They are suspected to be insignificant compared to emissions from other modules.

MODULE DEFAULT LISTING

MODULE NAME Wastewater Solvent Extraction (Phenosolvan)

Default No. 1 Pump Seals

a. If the number of pump seals is unknown, use
# pump seals = 1.4 x # of pumps.

b. If the service distribution is unknown, use
Aqueous = 50 % and Hydrocarbon Liquid = 50 %.

c. In the absence of any other reliable data, use
Aqueous service = 7 pump seals,
Hydrocarbon liquid service = 8 pump seals.

Default No. 2 Compressor Seals

a. If the number of compressor seals is unknown, use
# compressor seals = 2.0 x # of compressors.

b. If the service distribution is unknown, use
Hydrocarbon Gas = 0 % and Hydrogen Gas = 0 %.

c. In the absence of any other reliable data, use
Hydrocarbon Gas Service = 0 compressor seals,
Hydrogen Gas Service = 0 compressor seals.

Default No. 3 Valves

a. If the total number of valves is unknown, use
Total # valves = 24 x total # of pump seals

b. If the service distribution is unkonwn, use
HC Gas = 10 %, Hyd. Gas = 0 %,
Aqueous = 60 %
Hydrocarbon Liquid = 30 %

c. In the absence of any other reliable data, use
HC Gas = 37 valves,
Hyd. Gas = 0 valves,
Aqueous = 209 valves, and
Hydrocarbon Liquid = 112 valves.

MODULE DEFAULT LISTING (Continued)

MODULE NAME Wastewater Solvent Extraction (Phenosolvan)

Default No. 4 Connections

a. If the total number of connections is unknown, use
Total # connection = 4.3 x total # valves.

b. If the service distribution is unknown, use
HC Gas = 10 %
Aqueous = 60 %
Hydrocarbon Liquid = 30 %.

c. In the absence of any other reliable data, use
HC Gas = 133 connections
Aqueous = 916 connections
Hydrocarbon Liquid = 494 connections

Default No. 5 Relief Valves

a. If the service distribution is unknown, use
Gas service = 10 %,
Liquid service = 90 %.

b. In the absence of any other reliable data, use
Gas service = 2 relief valves,
Liquid service = 14 relief valves.

Default No. 6 Open-End Lines

a. If the number of open-end lines is unknown, use
# open-end lines = 1.1 x total # pump seals.

b. In the absence of any other reliable data, use
# open-end lines = 16 .

MODULE DEFAULT LISTING (Continued)

MODULE NAME Wastewater Solvent Extraction (Phenosolvan)

Default No. 7 Process Drains

a. If the total number of process drains is unknown, use
# process drains = 1.6 x total # pump seals.

b. In the absence of any other reliable data, use
# process drains = 24.

Default No. 7C Sample System Purging

c. If the total number of sampling systems is unknown, use
# sampling systems = 0.55 x total # pump seals.

d. In the absence of any other reliable data, use
# sampling systems = 8.

Default No. 8 Combustion Emissions

a. If the fuel type is unknown, use
Gas = 100 %, Fuel Oil = 0, and Coal = 0 %.

b. If the heater duties are unknown, use
0 Btu/________.

c. If the module capacity is unknown, use
0 = ________ x ________.
There are ordinarily no combustion emissions associated with this module.

Default No. 9 Point Source Emissions

There can be a number of low-volume, low-VOC concentration vents associated with this module. In the absence of any other reliable data, these emissions may be assumed to be negligible.

Default No. 10 Wastewater Generation

The flow rate of wastewater leaving the module is essentially equal to the influent wastewater rate.